PRELIMINARY REPORT

Biological Assessment and Fine Sediment Study

Pond Creek and Shibboleth Branch
Washington County, Missouri

Fall 2008 - Spring 2009

Prepared for:
Missouri Department of Natural Resources
Division of Environmental Quality
Water Protection Program
Water Pollution Control Branch

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TABLE OF CONTENTS

Section **Page**

1.0 Introduction....1
- 1.1 Objectives....2
- 1.2 Null Hypotheses....2

2.0 Methods....2
- 2.1 Study Timing....2
- 2.2 Study Area and Station Descriptions....3
  - 2.2.1 Ecological Drainage Unit....7
  - 2.2.2 Land Use Description....7
- 2.3 Stream Habitat Assessment Project Procedure....8
- 2.4 Biological Assessment....8
  - 2.4.1 Macroinvertebrate Sampling and Analyses....8
  - 2.4.2 Physicochemical Water Sampling and Analyses....9
  - 2.4.3 Discharge....10
- 2.5 Fine Sediment....10
  - 2.5.1 Fine Sediment Coverage Estimations....10
  - 2.5.2 Fine Sediment Character....11
- 2.6 Quality Control....12
- 2.7 Preliminary Report....12

3.0 Results....12
- 3.1 Stream Habitat Assessment....12
- 3.2 Biological Assessment....13
  - 3.2.1 Macroinvertebrate Community Analyses....13
  - 3.2.2 Physicochemical Water Quality Analyses....14
    - 3.2.2.1 Physicochemical Water Parameters....14
    - 3.2.2.2 Dissolved Metals....17
- 3.3 Fine Sediment Coverage and Character....17

4.0 Discussion....21
- 4.1 Pond Creek....21
  - 4.1.1 Stream Habitat Assessment....21
  - 4.1.2 Macroinvertebrate Community....22
  - 4.1.3 Water Quality....22
  - 4.1.4 Fine Sediment Coverage and Character....22
- 4.2 Shibboleth Branch....23
  - 4.2.1 Stream Habitat Assessment....23
  - 4.2.2 Macroinvertebrate Community....23
  - 4.2.3 Water Quality....23
  - 4.2.4 Fine Sediment Coverage and Character....24
- 4.3 Potential Bias....24

5.0 Summary....24

6.0 Conclusion....25

7.0 Literature Cited....26

TABLES

		Page
Table 1	Location and Descriptive Information for Tributaries and Candidate References	3
Table 2	Percent Land Cover in the Tributaries, Candidate Reference Stations, and the Ozark/Meramec EDU	7
Table 3	Stream Habitat Assessment Project Procedure (SHAPP) Scores and Comparisons with Control Stations	12
Table 4	Biological Criteria (BIOREF) Metric Scores, Biological Support Category, and Macroinvertebrate Stream Condition Index (MSCI) Scores for Pond Creek and Shibboleth Branch, Washington County, Fall 2008	13
Table 5	Biological Criteria (BIOREF) Metric Scores, Biological Support Category, and Macroinvertebrate Stream Condition Index (MSCI) Scores for Pond Creek and Shibboleth Branch, Washington County, Spring 2009	14
Table 6a	Physicochemical Water Parameters for Pond Creek and Shibboleth Branch Stations, Fall 2008	15
Table 6b	Physicochemical Water Parameters for Candidate Reference Stations, Fall 2008	15
Table 7a	Physicochemical Water Parameters for Pond Creek and Shibboleth Branch Stations, Spring 2009	16
Table 7b	Physicochemical Water Parameters for Candidate Reference Stations, Spring 2009	16
Table 8	Dissolved Metals and Hardness for Tributaries and Controls, Fall 2008	18
Table 9	Dissolved Metals and Hardness for Tributaries and Controls, Spring 2009	19
Table 10	Fine Sediment Percent Coverage	20
Table 11	Total Metals Character in the Fine Sediment (<2.0mm): Barium, Cadmium, Lead, and Zinc Concentrations (mg/kg Dry Weight)	21

FIGURES

Page

Figure 1 Tributaries in the Ozark/Meramec EDU, 2008-2009 4

Figure 2 Tributaries in Washington County, 2008-2009 5

Figure 3 Tributaries in Crawford, Dent, and Iron Counties 2008-2009.....6

Figure 4 Virtual grid of transects (T) and quadrats (in gray, numbered) for estimating percent fine sediment. Example: stream 20' wide; quadrat placement based on random numbers (e.g. 18, 9, 4, 17, 8, 2) 11

ATTACHMENTS

Appendix A Biological and Sediment Assessment Study Plan of Barite Mining Effects on Mill Creek and Mineral Fork Tributaries. Washington, Crawford, Dent, and Iron Counties, August 12, 2008

Appendix B Macroinvertebrate Bench Sheet Report for Tributary Stations Fall 2008 and Spring 2009 (Does not include spring 2009 candidate reference bench sheets)

Appendix C Fine Sediment Percentage Statistical Analysis: Kruskal-Wallis One Way Analysis of Variance on Ranks, Test Stations vs Controls Mean (Pond Creek=Pond C; SB=Shibboleth Branch)

1.0 Introduction

The watersheds of Mill Creek and Mineral Fork, Washington County have been extensively mined for barium. In the fall of 2005 and spring of 2006 the Environmental Services Program (**ESP**), Water Quality Monitoring Section (**WQMS**) conducted biological assessments on Mill Creek and Mineral Fork, Washington Counties (MDNR 2007a; MDNR 2007b). Mill Creek contained high dissolved barium concentrations, apparently either from runoff within the watershed or from in stream natural background occurrences. Mineral Fork had a relatively high level of dissolved barium concentrations with a continuous low level of chloride, which are indicators of mining activity, and wastewater influence. These reports suggested that biological assessments, stream habitat assessments, and benthic fine sediment studies should be conducted on tributaries of Mill Creek and Mineral Fork to determine if they were impaired.

Mine waste sedimentation has historically been responsible for smothering aquatic habitats within these and other streams, making them uninhabitable for some invertebrates (Ryck 1974; MDC 1997, 2006). Damage to some aquatic habitats and the potential for serious damage to several streams existed due to past lead and barite mining activity (MDC 1997; 2006). In 1975, the collapse of a barite tailings pond released a significant amount of metals laden fine sediment into Shibboleth Creek, a tributary to Mill Creek (Duchrow 1978). Heavy metals were found in fish of Mill Creek in a later study (Czarnezki and Trial 1997). Shibboleth Branch (WBID 2120), a downstream tributary to Mill Creek, was placed on the 2004/2006 303(d) list of impaired waters in Missouri for inorganic sediment potentially from barite tailings pond sources (MDNR 2009a). Fountain Farm Branch may contribute barite mining sediment to Mill Creek as well (MDNR 1994). Pond Creek (trib; WBID 2128), an upstream tributary to Mill Creek, is on the 303(d) list for inorganic sediment potentially from barite tailings pond sources (MDNR 2009a).

A study proposal was written to include a biological assessment, stream habitat assessment, and fine sediment study of the tributaries of Mill Creek and Mineral Fork, Washington County, August 12, 2008 (Appendix A). This study was conducted at the request of the Missouri Department of Natural Resources (**MDNR**), Water Protection Program (**WPP**), Water Pollution Control Branch (WPCB). The 2008-2009 biological assessment, stream habitat assessment, and fine sediment study were conducted by the Division of Environmental Quality (**DEQ**), Environmental Services Program (**ESP**), Water Quality Monitoring Section (**WQMS**) and Chemical Analysis Section (**CAS**).

This is a preliminary report. The focus of this report is *Pond Creek* (WBID 2128) and *Shibboleth Branch* (WBID 2120). While several other tributaries of Mill Creek and Mineral Fork were included in this project and in the tables, they are not mentioned in this report, or are referred to as “Tributaries”. This preliminary report includes macroinvertebrate metric comparisons with BIOREF (biocriteria generating reference) streams and does not include similar-sized stream comparisons or dominant macroinvertebrate family comparisons. Water quality and fine sediment coverage and

character are included in the tables. The final report will include these and other comparisons, which may lead to alternative conclusions.

1.1 Objectives

- Assess aquatic life protection designated use status of the macroinvertebrate community.

- Document nutrient and dissolved metals levels in the tributaries and assess water quality.

- Identify the relative quantity of fine sediment per area and quantify sediment metals character.

- Assess the quality of stream habitat.

1.2 Null Hypotheses

1. Biological metrics and Macroinvertebrate Stream Condition Index (**MSCI**) scores will be similar between test and control streams as well as wadeable/perennial stream biological criteria.

2. Physicochemical water quality will be similar at all stations and parameters will meet the Water Quality Standards (**WQS**) of Missouri (MDNR 2005b).

3. The relative coverage in fine sediment percentage observed in test streams will be similar to that of control streams.

4. Stream habitat quality will be similar between test and control tributaries.

2.0 Methods

Kenneth B. Lister (ESP), Mike Irwin (ESP), and staff of the WQMS conducted this study. Methods are outlined in this section. The study timing is outlined. The study area and station descriptions, Ecological Drainage Units (**EDUs**), and land uses are identified. Stream habitat assessment procedures are discussed. Biological assessment procedures, which include macroinvertebrate community and physicochemical water collection and analyses, are discussed.

2.1 Study Timing

Sampling was conducted in the fall of 2008 and the spring of 2009. Shibboleth Branch #3 and #2 will be sampled again in the fall of 2009 and results will be included in the final report. Fall macroinvertebrates, water quality samples, and stream habitat assessments were conducted between September 23 and October 1, 2009. A habitat assessment was conducted on Shibboleth Branch #3 on September 3, 2009. Fine sediment sampling was conducted between October 15 and October 22, 2009. Non-filterable residue (NFR) was sampled at Shibboleth Branch #3 on January 22, 2009. Spring macroinvertebrates and water quality samples were collected between March 23

and April 8, 2009. Biological assessments will also be conducted at Shibboleth Branch #3 and #2 in the fall 2009 field season.

2.2 Study Area and Station Descriptions

The study area includes 13 stations on 10 streams (Table 1; Figure 1). The tributaries are located within Washington, Iron, Dent, and Crawford counties (Figures 2 and 3). Eight stations are considered test streams and five are similar-size candidate reference streams.

Table 1
Location and Descriptive Information for Tributaries and Candidate References

Station	County	Location	Description; WBID	Purpose; Class
Pond Creek #2	Washington	NE sec.3, T. 37 N., R. 3 E. E703719 N4203308	Downstream Pond Creek Road; 2128	Test; C
Pond Creek #1	Washington	NW sec. 35, T. 38 N., R. 3 E. E704868 N4205941	Upstream confluence with Mill Creek; 2127	Test; P
Shibboleth Branch #3	Washington	NE sec. 21/NW sec. 22, T. 38 N., R. 3 E. E702030 N4209388	Apx 0.25 miles east of Hwy E on Powder Lake Spring Rd; 2120	Test; C
Shibboleth Branch #2	Washington	NW sec. 14, T. 38 N., R. 3 E. E704807 N4210506	End Johnson Road; 2120	Test; C
Shibboleth Branch #1	Washington	NW sec. 13, T. 38 N., R. 3 E. E705671 N4210490	Downstream bridge Johnson Road; 2119	Test; P
Trib. Old Mines Creek	Washington	NW sec. 30, T. 39 N., R. 3 E. E698562 N4216811	North/Downstream of MO Hwy 21; 2114	Test; C
Salt Pines Creek	Washington	NE sec. 31, T. 39 N., R. 3 E E697830 N4215928	North/Downstream of MO Hwy 21; 2113	Test; C
Fountain Farm Branch #1	Washington	NE sec. 33, T. 38 N., R. 3 E. E702139 N4205858	Upstream confluence with Mill Creek; 3657	Test; C
Brazil Creek	Washington	NE sec. 28, T. 38 N., R. 1 W. E672696 N4206120	Downstream USFS Brazil Creek Campground	Candidate Reference; P
Courtois Creek	Iron	SW sec. 28, T. 35 N., R. 1 W. E672115 N4175783	Downstream CR80A @ Goodwater, MO	Candidate Reference; U
East Fork Huzzah Creek	Dent	SW sec. 20, T. 34 N., R. 2 W. E659956 N4164882	Downstream LWB apx. 2 miles S on AC at Boss, MO	Candidate Reference; C
West Fork Huzzah Creek	Dent	SW sec. 15, T. 34 N., R. 3 W. E653573 N4166719	Downstream MO Hwy 32 at Howes Mill, MO; USFS	Candidate Reference; C
Shoal Creek	Crawford	NW sec. 22, T. 36 N., R. 2 W. E663955 N4187505	USFS-Big Shoal Creek Road apx. 3 miles NE Davisville	Candidate Reference; P

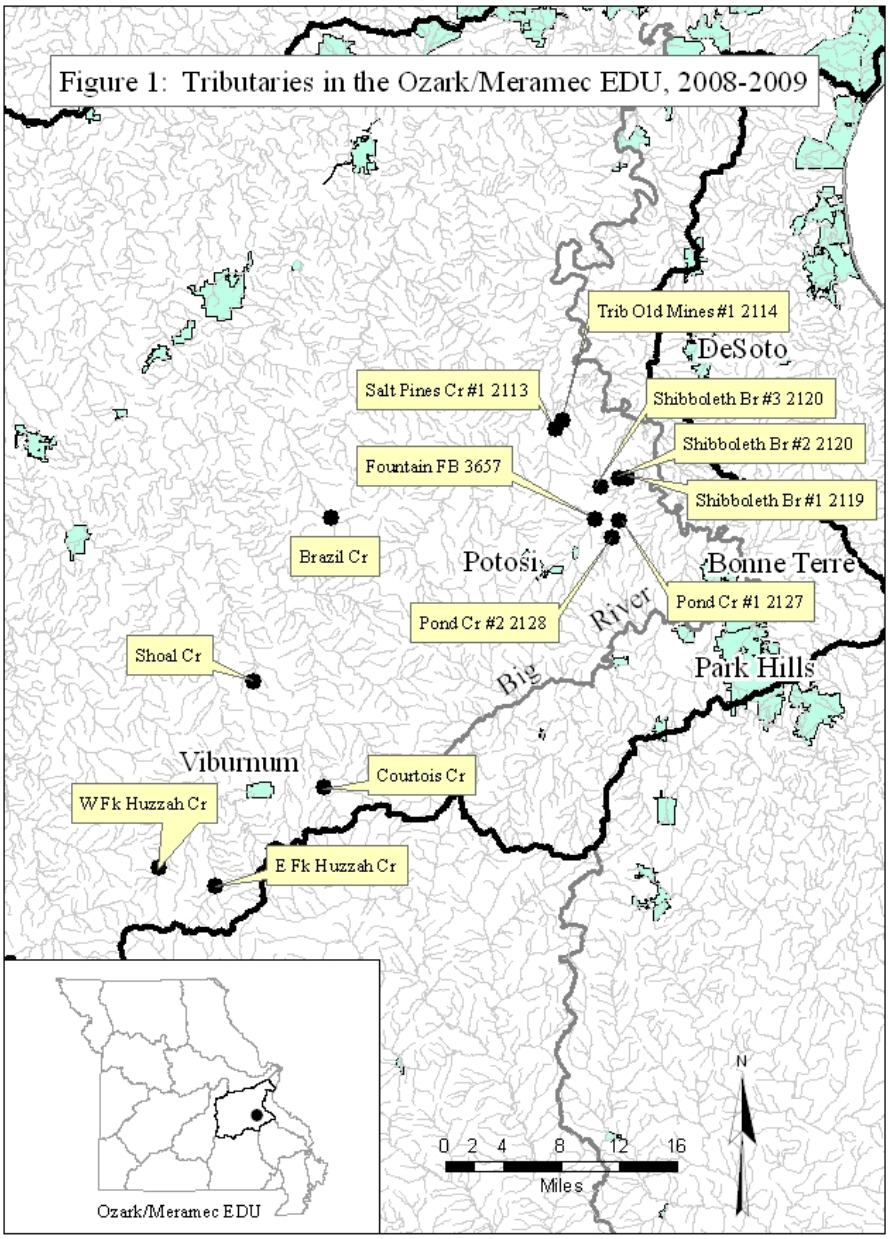


Figure 1: Tributaries in the Ozark/Meramec EDU, 2008-2009
Trib Old Mines #1 2114
DeSoto
Salt Pines Cr #1 2113
Shibboleth Br #3 2120
Shibboleth Br #2 2120
Fountain FB 3657
Shibboleth Br #1 2119
Brazil Cr
Potosi
Bonne Terre
Pond Cr #1 2127
Pond Cr #2 2128
River
Big
Shoal Cr
Park Hills
Viburnum
Courtois Cr
W Fk Huzzah Cr
E Fk Huzzah Cr
Ozark/Meramec EDU
0 2 4 8 12 16
Miles
N

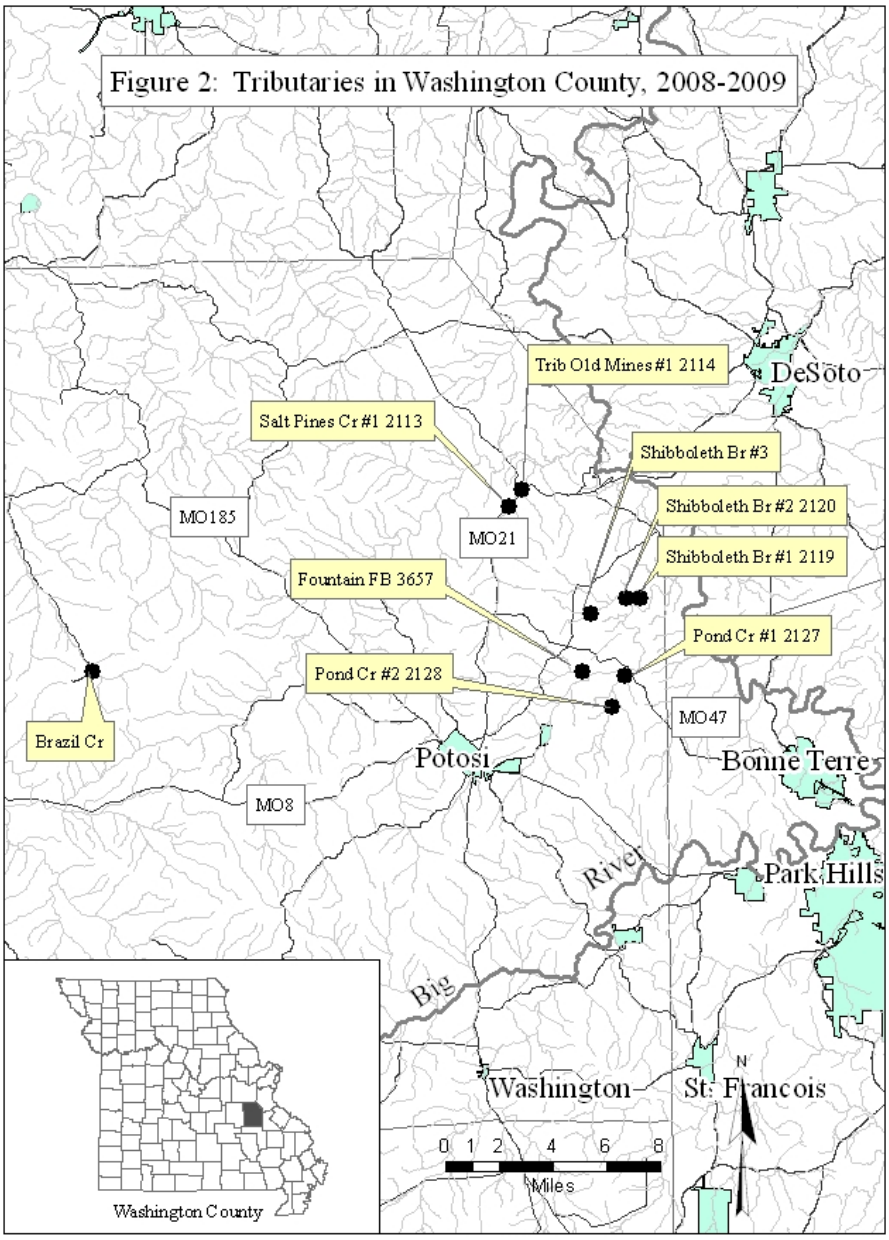


Figure 2: Tributaries in Washington County, 2008-2009
Trib Old Mines #1 2114
DeSoto
Salt Pines Cr #1 2113
Shibboleth Br #3
Shibboleth Br #2 2120
MO185
MO21
Shibboleth Br #1 2119
Fountain FB 3657
Pond Cr #1 2127
Pond Cr #2 2128
MO47
Brazil Cr
Potosi
Bonne Terre
MO8
Park Hills
Big
River
Washington
St. Francois
N
0 1 2 4 6 8
Miles
Washington County

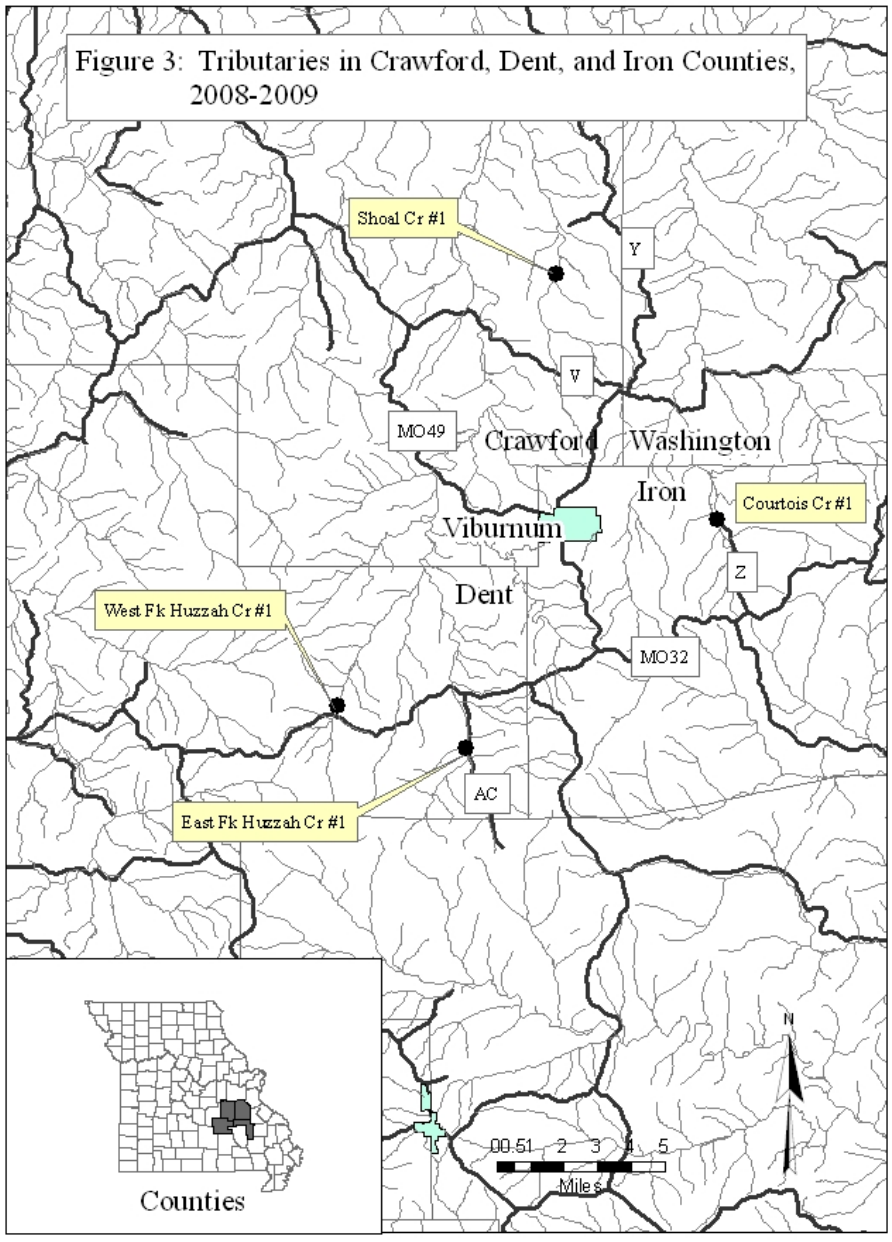


Figure 3: Tributaries in Crawford, Dent, and Iron Counties, 2008-2009
Shoal Cr #1
Y
V
MO49
Crawford
Washington
Iron
Courtois Cr #1
Viburnum
Z
Dent
West Fk Huzzah Cr #1
MO32
AC
East Fk Huzzah Cr #1
Counties
N
0 0.5 1 2 3 4 5
Miles

2.2.1 Ecological Drainage Unit

Tributaries are located within the Ozark/Meramec Ecological Drainage Unit (**EDU**; Figure 1). Ecological Drainage Units are delineated drainage units that are described by the physiographic and major riverine components. Similar size streams within an EDU are expected to contain similar aquatic communities and stream habitat conditions. Comparisons of biological and physicochemical results between test streams and similar size reference streams within the same EDU should then be appropriate.

2.2.2 Land Use Description

Land cover was compared between test stations, candidate references, and the Ozark/Meramec EDU using a 14-digit Hydrological Unit scale (**HUC-14**; Table 2). Percent land cover data were derived from Thematic Mapper satellite data collected between 2000 and 2004 and interpreted by the Missouri Resource Assessment Partnership (**MoRAP**). Land cover was relatively similar between the tributaries and the SHAPP control stations as well as with the general land cover of the Ozark/Meramec EDU (Table 2). All had a relatively high percentage of forest followed by grassland. General land use should not interfere with comparisons between stations and streams.

Table 2
Percent Land Cover in the Tributaries, Candidate Reference Stations, and the Ozark/Meramec EDU

Stations	HUC-14	Urban	Crops	Grass	Forest	Swamp	Open-water
Pond Creek #2, #1	07140104080002	6	0	15	73	1	1
Shibboleth Branch #3, #2, #1	"	"	"	"	"	"	"
Trib. Old Mines #1	07140104040003	1	0	10	83	2	1
Salt Pines Creek #1	"	"	"	"	"	"	"
Brazil Creek #1	07140102050005	0	0	15	83	0	0
Courtois Creek #1	07140102040001	1	0	8	86	0	0
East Fork Huzzah Creek #1	07140102030001	0	0	17	80	0	0
West Fork Huzzah Creek #1	"	"	"	"	"	"	"
Shoal Creek #1	07140102030004	0	0	17	80	0	0
Ozark/Meramec EDU	--	4	1	27	62	0	0

2.3 Stream Habitat Assessment Project Procedure

The standardized Stream Habitat Assessment Project Procedure (**SHAPP**) was followed as described for Riffle/Pool prevalent streams (MDNR 2003d). According to the SHAPP, the quality of an aquatic community is based on the ability of the stream to support the aquatic community. If SHAPP scores at test stations are ≥75% of the mean control scores, the stream habitat at the test station is considered to be comparable to the reference (control) stream. Brazil, Courtois, East Fork Huzzah, West Fork Huzzah, and Shoal Creeks in Washington, Iron, Dent, and Crawford counties, respectively, were used as SHAPP controls (Figure 1). Stream habitat assessment scores were also compared between stations from upstream to downstream when there was more than one station on a single stream.

2.4 Biological Assessment

Sampling was conducted as described in the MDNR Semi-quantitative Macroinvertebrate Stream Bioassessment Project Procedure (**SMSBPP,** MDNR 2003c). Biological assessments consist of macroinvertebrate community and physicochemical water collection and analyses.

2.4.1 Macroinvertebrate Sampling and Analyses

Macroinvertebrates were sampled from multiple habitats as described in the SMSBPP (MDNR 2003c). Pond Creek and Shibboleth Branch are considered riffle/pool dominant streams. As such, coarse substrate (**CS**; riffle), non-flowing water over depositional substrate (**NF**), and rootmat (**RM**) habitats were sampled. Macroinvertebrates were subsampled in the WQMS lab according to the SMSBPP and identified to specific taxonomic levels in order to standardize calculation of the metrics (MDNR 2003c; MDNR 2005a).

Macroinvertebrate community data were analyzed using three strategies. Macroinvertebrate Stream Condition Index (**MSCI**) scores, individual biological criteria metrics, and dominant macroinvertebrate families (**DMF**) were examined and compared from upstream to downstream.

A Macroinvertebrate Stream Condition Index (MSCI) is a qualitative rank measurement of a stream's aquatic biological integrity (Rabeni et al. 1997). The MSCI was further refined for reference streams within each EDU in Biological Criteria for Perennial/Wadeable Streams (**BIOREF,** MDNR 2002). A station's MSCI score ultimately identifies the ability of the stream to support the beneficial use for the protection of warm water aquatic life and human health-fish consumption (**AQL**).

The MSCI score is a compilation of rank scores that were assigned to individual biological criteria metrics as a measure of biological integrity. Four primary biological criteria metrics were used to calculate the MSCI per station: 1) Taxa Richness (**TR**); 2) Ephemeroptera/Plecoptera/Trichoptera Taxa (**EPTT**); 3) Biotic Index (**BI**); and 4) Shannon Diversity Index (**SDI**). Metric scores were compared to the BIOREF scoring range (SCI Scoring Table, Tables 4 and 5) and rank scores (5, 3, 1) were assigned to each metric (Tables 4 and 5). For each station, rank scores were compiled from all metrics and

the SCI was completed. The MSCI scores are interpreted as follows: 20-16 = full support of AQL; 14-10 = partial support of AQL; and 8-4 = non-support of AQL. SCI scores were compared between stations and grouped by season.

Secondly, the individual biological criteria metrics for each station were compared to the BIOREF scoring range to identify the level of integrity for each individual metric. Variations in the metrics may help identify how a community is affected and the potential source of impairment.

The third biological analysis included an evaluation of the "dominant macroinvertebrate families" (**DMF**) per station. The ten most abundant DMF for each station are listed as a percentage of the total number of individuals in the sample. Dominance by certain families may also help identify the type and source of impairment. A taxa list reported by season and station is attached as Appendix A.

2.4.2 Physicochemical Water Sampling and Analyses

Physicochemical water samples were handled according to the appropriate MDNR, ESP Standard Operating Procedures (**SOP**) and/or Project Procedures (**PP**) for sampling and analyzing physicochemical water samples. Results for physicochemical water variables were examined by season and station.

Fall 2008 and spring 2009 physicochemical water parameters consisted of field measurements and grab samples, which were returned to the ESP environmental laboratory. Water was sampled according to the SOP MDNR-FSS-001 Required/Recommended Containers, Volumes, Preservatives, Holding Times, and Special Sampling Considerations (MDNR 2009b). All samples were kept on ice during transport to ESP.

Temperature (C^o), pH, conductivity (uS), dissolved oxygen (mg/L), and discharge (cubic feet per second-**cfs**) were measured *in situ*. The ESP, Chemical Analysis Section (CAS) in Jefferson City, Missouri conducted analyses for ammonia as nitrogen (**NH_3-N;** mg/L), nitrate+nitrite as nitrogen (**NO_3+NO_2-N;** mg/L), total nitrogen (**TN**; mg/L), chloride (**Cl;** mg/L), total phosphorus (**TP;** mg/L), and non-filterable residue (**NFR;** mg/L). Turbidity (**NTU**) was measured and recorded in the WQMS biology laboratory. Samples for dissolved metals (barium, cadmium, calcium, cobalt, copper, lead, magnesium, nickel, and zinc) were filtered in the field and analyzed by the CAS.

Physicochemical water parameters were compared between stations from upstream to downstream as well as with acceptable limits in Missouri's Water Quality Standards (**WQS**, MDNR 2005b). Interpretation of acceptable limits in the WQS may be dependent on a stream's classification and its beneficial-use designation (MDNR 2005b). Pond Creek and Shibboleth Branch are both class C upstream and class P downstream with designated beneficial uses for LWW, AQL, and WBC category B. Furthermore, acceptable limits for some parameters may be dependent on the rate of exposure. These

exposure or toxicity limits are based on the lethality of a toxicant given long (chronic toxicity) or short-term exposure (acute toxicity).

2.4.3 Discharge

Stream discharge was measured using a Marsh-McBirney Flowmate™ flow meter at each station. Velocity and depth measurements were recorded at each station according to SOP MDNR-WQMS-113 Flow Measurement in Open Channels (MDNR 2003b).

2.5 Fine Sediment

In-stream deposits of fine sediment (i.e. particle size ca. <2 mm) were estimated for percent coverage per area and characterized for composition of total recoverable metals (**TR;** ug/kg). The ESP, CAS conducted metals analyses.

2.5.1 Fine Sediment Coverage Estimations

The relative percentage of fine sediment (<2.0 mm) coverage was visually estimated for each station. The visual estimates were conducted within a metal square (**quadrat**) that was randomly located in sample areas called grids (Figure 3). Each station contained three grids. This method allowed for estimation and comparison of benthic fine sediment between stations.

In order to ensure sampling method uniformity, grids were located at lower margins of riffles or runs and the upper margin of pool habitats in areas of relatively laminar flow. This arrangement or placement of grids was similar to previous fine sediment assessment projects done by the WQMS (MDNR-WQMS Reports: Flat River 2001, MDNR 2001; Upper Big River 2001-2002, MDNR 2003a). Water velocity was no greater than 0.5 feet per second (**fps**), which allows fine sediment sized particles (<2.0mm) to settle from transport after high flow events, according to the Hjulstrom Diagram (1939) for threshold transport and settling velocities. A Marsh-McBirney flow meter was used to determine maximum velocity within the proposed grid. Depths did not exceed three (3.0) feet. Grids did not include eddies, bends, downstream of vegetation, or large obstructions that have turbulent flow.

Once a suitable area was identified, a virtual grid was constructed (Figure 3). A 100' tape measure anchored across the stream became the downstream transverse edge of a virtual grid of six contiguous transects. Each transect was 12" deep and as wide as the useable grid and was identified by holding a retractable tape measure perpendicular to the 100' tape. The useable grid width included the width of the stream with relatively laminar flow that excluded eddies, vegetation, and large obstructions. Random numbers, equating to one foot increments, were drawn to determine where the quadrat was placed along each transect. The quadrat was placed within the transect, with the downstream edge contacting the downstream transect edge. Two observers estimated/recorded the percent of fine sediment within the quadrat. The estimates were accepted and recorded if the two observations were within a ten percent margin of error or rejected and repeated until the margin of error was reached. Another random number was drawn and the quadrat was randomly placed in the next transect upstream where the next observation

was made. This continued until fine sediment was estimated in each of the six quadrats (one per transect).

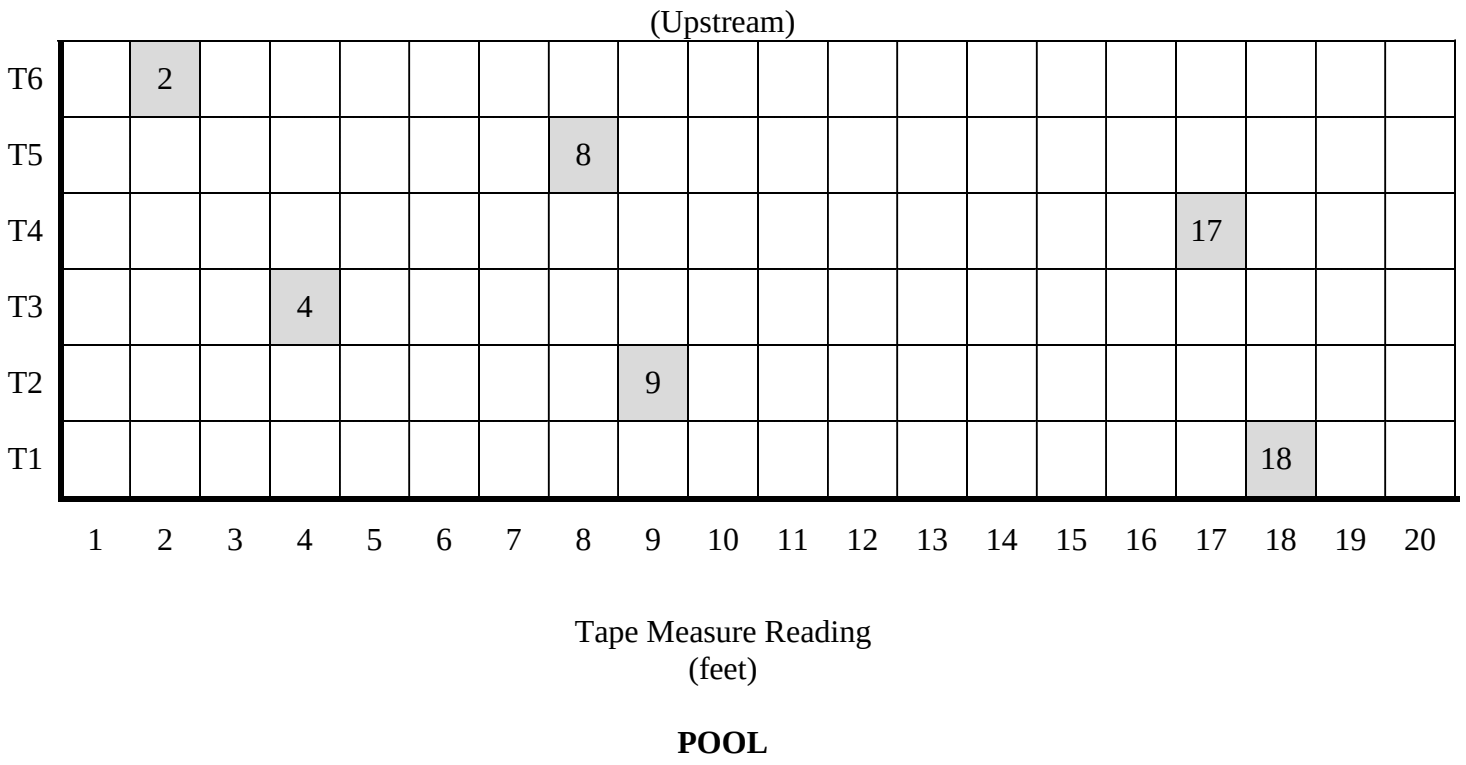
The coverage data will be compared using Analysis of Variance on Ranks, with multiple comparison procedures if differences are detected (SigmaStat version 3.5 2006).

2.5.2 Fine Sediment Character

Fine sediment was sampled within each sample station. Each station's sample consisted of three 2-ounce grab samples from within each grid. The three samples were composited. The fine sediment was subsampled from the composite sample for analysis by CAS.

The consensus-based Probable Effects Concentration (**PEC**) for lead, cadmium, and zinc in sediment was compared to mean level of the mine-related material. The PEC is the level of a contaminant above which harmful effects are likely to be observed. The PEC for lead is 128 mg/kg dry weight. The PEC for cadmium is 4.98 mg/kg. The PEC for zinc is 459 mg/kg. (MacDonald et al. 2000).

Figure 4: Virtual grid of transects (T) and quadrats (in gray, numbered) for estimating percent fine sediment. Example: stream 20' wide; quadrat placement based on random numbers (e.g. 18, 9, 4, 17, 8, 2).



2.6 Quality Control

Quality control was conducted in accordance with MDNR Standard Operating Procedures. Macroinvertebrate community and water physicochemical variables were duplicated at Courtois Creek in fall 2008 and Brazil Creek in spring 2009 (e.g. 1a and 1b). The results were similar between duplicates illustrating little difference between collectors, collection methods, containers, and analytical methods or processes.

2.7 Preliminary Report

This is a preliminary report and as such does not include all analyses for all stations. The focus is on *Pond Creek* and *Shibboleth Branch* due to schedule deadlines for study of these two streams. Water quality and sediment data are shown for candidate references. Tables and figures may contain results from other stations, however, interpretation and narrative are limited to the two streams and references (when available) in this draft.

3.0 Results

Results are grouped by stream habitat assessment, biological assessment, fine sediment coverage estimations, and characterization. Trends and exceptional results are highlighted.

3.1 Stream Habitat Assessment

All test station stream habitat assessment scores were comparable to the average SHAPP score for control streams (Table 3). Scores were well above the >75 percent similarity between test stations to control stations (MDNR 2003d). Pond Creek #2 and #1 achieved 89 and 100 percent of the control score, respectively. Shibboleth Branch #2 scored 85 percent and #1 scored 81 percent of the average of controls. Shibboleth Branch #3 was assessed on September 3, 2009 and scored within the acceptable range.

Table 3
Stream Habitat Assessment Project Procedure (SHAPP) Scores
and Comparisons with Control Stations

Station	SHAPP Score	Percent of control average
Pond Creek #2	139	89
Pond Creek #1	162	100
Shibboleth Branch #3	134	86
Shibboleth Branch #2	132	85
Shibboleth Branch #1	126	81
Tributary Old Mines #1	146	93
Salt Pines Creek #1	128	82
Fountain Farm Branch #1	141	90
Brazil Creek #1 (control)	161	156 control average
Courtois Creek #1 (control)	146	
West Fork Huzzah Creek #1 (control)	169	
East Fork Huzzah Creek #1 (control)	152	
Shoal Creek #1 (control)	151	

3.2 Biological Assessment

Biological assessment consisted of macroinvertebrate community analyses and physicochemical water quality analyses. Results are compared between stations from upstream to downstream.

3.2.1 Macroinvertebrate Community Analyses

The macroinvertebrate community is examined in this section. Macroinvertebrate Stream Condition Index scores and individual metric scores are examined for each test station for the fall and spring seasons. Dominant macroinvertebrate families are not examined.

One of the four stations was partially supporting the designated use category AQL in the fall of 2008 (Table 4). Pond Creek #2 had an MSCI score of 12, which assigned it to the partial support category. Individual metrics show that TR, EPTT, BI, and SDI contributed to the lower score.

Table 4
Biological Criteria (BIOREF) Metric Scores, Biological Support Category, and Macroinvertebrate Stream Condition Index (MSCI) Scores for Pond Creek and Shibboleth Branch, Washington County, Fall 2008

Stream and Station Number	Sample No.	TR	EPTT	BI	SDI	MSCI	Support
Pond Creek #2	0804107	**78**	**18**	**6.7**	**2.89**	**12**	**P**
Pond Creek #1	0804105	104	31	5.3	3.75	20	F
Shibboleth Branch #2	0804109	91	25	**5.9**	3.33	18	F
Shibboleth Branch #1	0804108	90	24	**6.5**	**3.08**	16	F
BIOREF Score=5	--	>79	>21	<5.8	>3.09	20-16	**F**ull
BIOREF Score=3	--	79-39	21-11	5.8-7.9	3.09-1.55	14-10	**P**artial
BIOREF Score=1	--	<39	<11	>7.9	<1.55	8-4	**N**on

MSCI Scoring Table (in light gray) developed from BIOREF streams (n=7); TR=taxa richness; EPTT=Ephemeroptera, Plecoptera, Trichoptera Taxa; BI=Biotic Index; SDI=Shannon Diversity Index
Bold=less than optimum BIOREF score

Two stations were partially supporting in the spring of 2009 (Table 5). Pond Creek #2 was partially supporting with an MSCI score of 12. Individual metrics that include TR, EPTT, BI, and SDI contributed to the score at PC #2. Shibboleth Branch #3 was also in the partial category with a slightly higher MSCI score of 14. Individual metrics that contributed to the score included TR, EPTT, and SDI. The BI was low and well within the optimum BIOREF scoring range.

An individual taxa list is included in Appendix B.

Table 5
Biological Criteria (BIOREF) Metric Scores, Biological Support Category, and Macroinvertebrate Stream Condition Index (MSCI) Scores for Pond Creek and Shibboleth Branch, Washington County, Spring 2009

Stream and Station Number	Sample No.	TR	EPTT	BI	SDI	MSCI	Support
Pond Creek #2	0930003	**90**	**24**	**6.1**	**3.16**	**12**	**P**
Pond Creek #1	0930002	90	26	5.5	3.69	16	F
Shibboleth Branch #3	0930012	**69**	**18**	4.3	**3.23**	**14**	**P**
Shibboleth Branch #2	0930006	97	30	5.6	3.47	20	F
Shibboleth Branch #1	0930005	112	33	**5.8**	3.78	18	F
BIOREF Score=5	--	>92	>29	<5.8	>3.33	20-16	**F**ull
BIOREF Score=3	--	92-46	29-15	5.8-7.9	3.33-1.67	14-10	**P**artial
BIOREF Score=1	--	<46	<15	>7.9	<1.67	8-4	**N**on

MSCI Scoring Table (in light gray) developed from BIOREF streams (n=6); TR=taxa richness; EPTT=Ephemeroptera, Plecoptera, Trichoptera Taxa; BI=Biotic Index; SDI=Shannon Diversity Index
Bold=less than optimum BIOREF score

3.2.2 Physicochemical Water Quality Analyses

Physicochemical water parameters and dissolved metals are examined.

3.2.2.1 Physicochemical Water Parameters

Physicochemical water parameters were relatively unremarkable for both the fall and spring sample seasons. Fall samples were slightly elevated for total nitrogen, nitrate, and chloride at Shibboleth Branch stations when compared to reference station samples (Tables 6a and 6b). Spring samples also found all three Shibboleth Branch samples slightly elevated for total nitrogen and stations #2 and #1 for chloride (Tables 7a and 7b).

Table 6a
Physicochemical Water Parameters for Pond Creek and Shibboleth Branch Stations, Fall 2008

Station Variable/ Date	Pond Creek #2 9/24/08	Pond Creek #1 9/24/08	Shibboleth Branch #2 9/24/08	Shibboleth Branch #1 9/25/08
Sample Number	0810006	0810004	0810008	0810007
pH (Units)	8.3	8.1	8.3	8.2
Temperature (C^0)	17.0	16.0	18.0	17.0
Conductivity (uS)	199	366	365	371
Dissolved O_2	7.21	7.97	7.86	7.97
Discharge (cfs)	1.56	5.37	5.71	6.43
*NFR	<5.0	<5.0	<5.0	<5.0
Turbidity (NTUs)	1.55	7.18	10.2	2.44
Total Nitrogen	0.17	0.09	**0.22**	**0.24**
Nitrate+Nitrite-N	<0.01	<0.01	**0.08**	**0.11**
Ammonia-N	<0.03	<0.03	<0.03	<0.03
Chloride	2.01	2.85	3.29	3.36
Total Phosphorus	0.01	0.01	0.02	0.01

* NFR collected January 22, 2009

Table 6b
Physicochemical Water Parameters for Candidate Reference Stations, Fall 2008

Station Variable/ Date	Brazil Creek #1	Courtois Creek #1a	Courtois Creek #1b	East Fork Huzzah Creek #1	West Fork Huzzah Creek #1	Shoal Creek #1
Sample Number	0810003	0810010	0810011	0810012	0810015	0810009
pH (Units)	8.2	7.75	--	7.32	7.77	8.3
Temperature (C^0)	18	15	--	18.0	17.0	20.0
Conductivity (uS)	252	266	--	344	268	385
Dissolved O_2	7.20	8.55	--	7.45	7.93	8.00
Discharge (cfs)	2.73	3.55	--	5.14	2.84	3.03
Turbidity (NTUs)	1.10	<1.0	<1.0	5.47	1.08	<1.00
Total Nitrogen	0.30	0.03	0.05	0.13	0.11	0.10
Nitrate+Nitrite-N	0.13	0.01	0.04	0.08	0.02	0.02
Ammonia-N	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Chloride	1.72	1.81	1.80	2.76	2.68	2.56
Total Phosphorus	0.03	0.01	0.01	0.02	0.01	0.01

NFR was not sampled for controls in the fall

Table 7a
Physicochemical Water Parameters for Pond Creek and Shibboleth Branch Stations, Spring 2009

Station Variable/ Date	Pond Creek #2 3/23/09	Pond Creek #1 3/23/09	Shibboleth Branch #3 4/01/09	Shibboleth Branch #2 3/25/09	Shibboleth Branch #1 3/25/09
Sample Number	0912003	0912002	0912012	0912006	0912005
pH (Units)	8.20	8.40	8.00	8.50	8.50
Temperature (C^0)	14.0	12.0	11.0	11.0	10.0
Conductivity (uS)	326	435	265	375	386
Dissolved O_2	10.4	11.2	9.21	10.8	11.3
Discharge (cfs)	0.51	1.27	3.03	6.70	9.63
NFR	<5.0	<5.0	<5.0	<5.0	<5.0
Turbidity (NTUs)	3.00	1.00	3.83	5.98	6.56
Total Nitrogen	0.08	0.08	**0.20**	**0.24**	**0.28**
Nitrate+Nitrite-N	0.02	<0.01	0.02	0.10	0.13
Ammonia-N	<0.03	<0.03	<0.03	<0.03	<0.03
Chloride	3.81	4.72	4.26	4.03	4.10
Total Phosphorus	<0.01	<0.01	<0.01	<0.01	<0.01

(Units mg/L unless otherwise noted; **Bold**=Out of WQS acceptable range or trend)

Table 7b
Physicochemical Water Parameters for Candidate Reference Stations, Spring 2009

Station Variable/ Date	Brazil Creek #1a	Brazil Creek #1b	Courtois Creek #1	East Fork Huzzah Creek #1	West Fork Huzzah Creek #1	Shoal Creek #1
Sample Number	0912009	0912010	0912011	0912016	0912017	0912008
pH (Units)	8.10	--	8.20	8.40	8.70	8.60
Temperature (C^0)	10	--	12	11	14	15
Conductivity (uS)	235	--	171	275	226	329
Dissolved O_2	9.66	--	9.16	9.40	10.7	9.91
Discharge (cfs)	5.23	--	17.7	10.9	3.56	10.5
NFR	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Turbidity (NTUs)	2.05	1.84	2.80	<1.0	1.01	4.90
Total Nitrogen	0.16	0.16	0.08	0.11	0.12	0.14
Nitrate+Nitrite-N	0.07	0.07	<0.01	0.04	0.04	<0.01
Ammonia-N	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Chloride	1.54	1.60	2.02	2.58	2.90	2.25
Total Phosphorus	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

(Units mg/L unless otherwise noted; **Bold**=Out of WQS acceptable range or trend)

3.2.2.2 Dissolved Metals

Pond Creek and Shibboleth Branch water samples contained elevated dissolved metals concentrations in the fall of 2008 (Table 9). Pond Creek barium concentrations ranged from 557 to 618 mg/L barium. Shibboleth Branch stations contained dissolved barium in the mid 700 mg/L range. Shibboleth Branch #2 also contained dissolved zinc above the reference levels. Dissolved barium at Pond Creek and zinc at Shibboleth Branch stations were slightly higher than those found in references, indicating they were not background levels. However, dissolved metals did not exceed WQSs in the fall (MDNR 2005b).

Pond Creek and Shibboleth Branch stations contained dissolved metals in the spring of 2009 (Table 9). Pond Creek stations were found to contain dissolved barium and zinc above concentrations at reference stations. Shibboleth Branch stations #2 and #1 contained dissolved barium, lead, nickel, and zinc above levels of the references. Shibboleth Branch #3 contained barium, lead, and nickel. These dissolved metals were higher in Pond Creek and Shibboleth Branch than the references, indicating they were not background levels. None of the dissolved metal concentrations exceeded Water Quality Standards (WQSs; MDNR 2005b) in the spring.

3.3 Fine Sediment Coverage and Character

Fine sediment coverage was greater at most Pond and Shibboleth Branch stations than the references (Table 10). Fine sediment mean coverage ranged from 37 to 93 percent coverage at Pond and Shibboleth stations and from 10 to 22 percent at the controls. Due to a failure of normality, ANOVA on Ranks and Dunn's Method of multiple comparisons were conducted (Appendix C). The medians illustrated that Pond Creek #2 and #1 and Shibboleth #2 and #1 all had significantly ($p<0.05$) more fine sediment than the controls. Shibboleth Branch #3 did not have significantly more fine sediment coverage than the grouped control/reference stations.

Total metals concentrations in the fine sediment were detected above Probable Effects Concentrations (PECs; MacDonald et al. 2000) in the fine sediment at Pond Creek and Shibboleth Branch (Table 11). Both Pond Creek stations had high barium and zinc levels above PECs. All Shibboleth Branch stations had elevated barium, while lead and zinc were above PECs. Shibboleth Branch #1 also had cadmium above PECs.

Table 8
Dissolved Metals and Hardness for Tributaries and Controls, Fall 2008

Parameter Station	Ba	Cd	Ca	Co	Cu	Pb	Mg	Ni	Zn	HARD CaCO3
Pond Cr #2	**557**	<0.20	20.2	<1.0	0.78	<0.25	12.1	<0.25	3.18	100
Pond Cr #1	**618**	<0.20	40.9	<1.0	0.55	<0.25	24.1	<0.25	5.61	202
Shibboleth Br #2	**748**	<0.20	40.3	<1.0	0.80	<0.25	23.7	<0.25	**13.1**	198
Shibboleth Br #1	**758**	<0.20	41.5	<1.0	0.79	<0.25	24.8	<0.25	7.35	206
Fountain Farm Br #1	**674**	<0.20	43.5	<1.0	0.95	**0.30**	25.8	<0.25	**11.0**	215
Trib Old Mines #1	**1030**	<0.20	45.1	<1.0	2.08	**0.49**	29.7	<0.25	**22.0**	235
Salt Pines Cr #1	**877**	<0.20	48.1	<1.0	1.34	**0.37**	29.5	<0.25	2.60	242
Brazil Cr #1 c	86.1	<0.20	27.9	<1.0	0.70	<0.25	16.3	<0.25	2.28	137
Courtois Cr #1A c	45.8	<0.20	28.7	<1.0	0.59	<0.25	17.3	<0.25	1.50	143
Courtois Cr #1B c	45.1	<0.20	28.7	<1.0	0.51	<0.25	17.3	<0.25	1.34	143
E Fk Huzzah Cr #1 c	48.9	<0.20	36.4	<1.0	0.75	<0.25	22.4	<0.25	8.13	183
W Fk Huzzah Cr #1 c	38.8	<0.20	29.3	<1.0	0.52	<0.25	17.6	<0.25	1.36	146
Shoal Creek #1 c	51.0	<0.20	42.9	<1.0	1.81	<0.25	25.8	<0.25	3.34	213

Units ug/L; **Bold**=trend

Table 9
Dissolved Metals and Hardness for Tributaries and Controls, Spring 2009

Parameter Station	Ba	Cd	Ca	Co	Cu	Pb	Mg	Ni	Zn	HARD CaCO3
Pond Cr #2	**469**	<0.20	32.2	<1.0	1.24	<0.25	18.7	<0.25	**9.83**	158
Pond Cr #1	**612**	<0.20	43.9	<1.0	1.26	<0.25	26.7	<0.25	**8.46**	220
Shibboleth Br #3	**980**	<0.20	24.9	<1.0	1.02	**0.52**	15.1	**0.44**	6.63	124
Shibboleth Br #2	**609**	<0.20	37.1	<1.0	1.24	**0.32**	22.3	**0.47**	**28.1**	184
Shibboleth Br #1	**604**	<0.20	38.2	<1.0	1.34	**0.26**	22.8	**0.45**	**20.9**	189
Fountain Farm Br #1	**565**	<0.20	46.6	<1.0	1.28	<0.25	27.7	**0.37**	**21.3**	231
Trib Old Mines #1	**867**	<0.20	44.4	<1.0	1.34	<0.25	29.5	**0.43**	**20.1**	232
Salt Pines Cr #1	**1130**	<0.20	54.6	<1.0	1.23	<0.25	32.9	**0.33**	1.90	272
Brazil Cr #1A	75.9	<0.20	23.9	<1.0	1.00	<0.25	13.8	**0.30**	7.77	116
Brazil Cr #1B	70.7	<0.20	23.7	<1.0	0.64	<0.25	13.7	<0.25	2.21	116
Courtois Cr #1	28.6	<0.20	17.2	<1.0	0.92	<0.25	9.91	<0.25	2.28	83.7
E Fk Huzzah Cr #1	28.5	<0.20	30.4	<1.0	0.71	<0.25	18.7	<0.25	6.82	153
W Fk Huzzah Cr #1	32.7	<0.20	24.2	<1.0	0.54	<0.25	14.6	<0.25	1.65	121
Shoal Cr #1	38.7	<0.20	34.6	<1.0	1.23	<0.25	20.5	0.29	2.09	171

Units ug/L; **Bold**=trend

Table 10
Fine Sediment Percent Coverage

Grid-Transect	Pond Creek #2	Pond Creek #1	Shibboleth Branch #3	Shibboleth Branch #2	Shibboleth Branch #1	Brazil Creek #1	Courtois Creek #1	East Fork Huzzah Creek #1	West Fork Huzzah Creek #1	Shoal Creek #1
1-1	92	25	6	13	40	30	27	3	3	3
1-2	99	55	3	13	43	15	17	4	3	1
1-3	95	10	90	55	15	7	7	7	3	1
1-4	95	40	25	68	17	40	10	9	7	1
1-5	90	5	7	37	33	23	4	1	7	7
1-6	85	50	13	19	20	23	7	4	1	1
2-1	98	27	5	7	77	9	3	4	4	23
2-2	95	45	6	13	13	5	1	3	3	20
2-3	95	10	5	81	23	80	10	1	2	23
2-4	95	25	85	5	10	35	17	5	3	87
2-5	90	55	5	23	7	40	5	1	70	80
2-6	89	13	3	13	15	35	1	5	53	63
3-1	95	75	90	33	43	2	35	45	3	3
3-2	95	23	17	73	77	9	12	45	1	15
3-3	87	70	87	85	80	1	70	17	5	7
3-4	97	93	87	80	85	23	25	17	7	20
3-5	90	27	95	95	77	15	1	7	2	8
3-6	97	23	95	95	67	7	13	13	3	13
MEAN	**93.3**	**37.3**	**40.2**	**44.9**	**41.2**	**22.2**	**14.7**	**10.6**	**10.0**	**20.9**
S.D.	**3.9**	**24.8**	**41.1**	**33.5**	**28.4**	**19.5**	**16.8**	**13.4**	**19.1**	**27.1**
Diff vs. mean controls	<0.05	<0.05	NS	<0.05	<0.05	19.2 mean of controls				

Table 11
Total Metals Character in the Fine Sediment (<2.0mm): Barium, Cadmium, Lead, and Zinc Concentrations (mg/kg Dry Weight)

Parameter Station	Barium	Cadmium	Lead	Zinc
Pond Creek #2	1580	0.683	46.6	**488**
Pond Creek #1	1460	0.594	96.8	**525**
Shibboleth Branch #3	2890	0.638	**836**	**697**
Shibboleth Branch #2	2350	0.544	**246**	**845**
Shibboleth Branch #1	428	**9.52**	**607**	**553**
Fountain Farm Br#1	1930	0.481	**237**	**606**
Trib Old Mines #1	2940	1.56	**707**	**1610**
Salt Pines Creek #1	3050	2.09	**660**	**1220**
Brazil Creek #1	24.8	0.101	49.3	54.6
Courtois Creek #1	13.3	0.100	8.7	9.5
E Fk Huzzah Cr#1a	19.0	0.599	15.1	64.5
E Fk Huzzah Cr#1b	18.6	0.381	13.4	45.6
W Fk Huzzah Cr#1	21.6	0.100	10.8	9.5
Shoal Creek #1	15.7	0.169	15.9	45.4
PEC	--	**4.98** mg/kg	**128** mg/kg	**459** mg/kg

(PEC=Probable Effects Concentration, MacDonald et al. 2000; a and b=duplicate; light gray=candidate reference stations; **Bold**=above PEC)

4.0 Discussion

The discussion is arranged by the tributaries of Mill Creek. The streams in this preliminary report discussion are Pond Creek and Shibboleth Branch. It does not include Fountain Farm Branch, the remaining tributary of Mill Creek in the study, which will be included in the final report. The macroinvertebrate community, water quality, and fine sediment coverage and character are discussed for each stream.

4.1 Pond Creek

One station on Pond Creek was impaired during both sample seasons. The stream habitat assessment, macroinvertebrate community, water quality, and fine sediment coverage and character are discussed for both stations.

4.1.1 Stream Habitat Assessment

All stations on Pond Creek scored above the acceptable threshold of 75 percent similarity to the mean of SHAPP controls. Pond Creek #2 was predominantly a small bedrock dominant stream segment with a coating of fine sediment. Pond Creek #1 was larger with more epifaunal substrate and less sediment deposition.

4.1.2 Macroinvertebrate Community

Pond Creek #2 was partially supportive of the AQL in fall 2008 and spring 2009. All individual metrics, TR, EPTT, BI, and SDI, were less than optimum and contributed to the low MSCI score. The spring score was much higher and close to the BIOREF optimum range for all of the metrics, yet all metrics were less than optimal. This suggests that metrics fluctuated but not enough to attain the optimum range. The BI was high during both seasons and suggested that organic influences may have altered the community.

4.1.3 Water Quality

Pond Creek water quality was relatively unremarkable with two exceptions. The high BI suggests that nutrients should be elevated, however, nutrients were not elevated in either season's samples. These results did not identify an obvious organic influence, however, nutrients concentrations may fluctuate.

Dissolved metals were detected during both seasons. Dissolved barium was above reference concentrations at both stations in both seasons. Dissolved zinc was found at both stations in concentrations above the references during the spring. The presence of these metals in concentrations above reference levels suggests that mining in the watershed may be contributing metals to Pond Creek, and ultimately Mill Creek. However, none of the dissolved heavy metals included in this project exceeded WQSs (MDNR 2005b).

4.1.4 Fine Sediment Coverage and Character

Pond Creek #2 and #1 had significantly higher ($p<0.05$) coverage of fine sediment than the median of the references/controls. The means at the Pond Creek stations ranged from 93 to 37 ($\pm$25) percent coverage, respectively. The quantity of fine sediment is a potential contributor that may have altered community in the upstream station, as observed in the MSCI score. Coverage at station #1 was patchy and therefore not normally distributed. Evidence of this is found in the individual taxa lists, where burrowers *Hexagenia* were found in the same station with *Isonychia*, a taxon that is intolerant to fine sediment, according to Zweig and Rabeni (2001).

The fine sediment found at both Pond Creek stations contained barium, as well as zinc in concentrations above the PEC. The fine sediment in reference stations contained metals at much lower concentrations, suggesting that the Pond Creek fine sediment metals were not in background levels. The zinc concentrations may have affected the composition of the macroinvertebrate community at both stations. However, station #2 had an MSCI score that was lower than #1 in both seasons, with slightly lower levels of zinc in the fine sediment. If zinc were influencing the Pond Creek stations, Pond Creek #1 with higher zinc levels in the fine sediment should have been equally impaired.

4.2 Shibboleth Branch

One station on Shibboleth Branch was impaired during the spring 2009 season. The stream habitat assessment, macroinvertebrate community, water quality, and fine sediment coverage and character are discussed for Shibboleth Branch stations.

4.2.1 Stream Habitat Assessment

All stations on Shibboleth Branch exceeded the minimum 75 percent comparability threshold to the SHAPP controls. Shibboleth Branch #3 was assessed twice; once in spring 2009 and once in fall 2009. The score in the fall was lower than the spring score mainly due to the presence of a much higher percentage of fine sediment deposition. This suggests that sediment deposition may seasonally fluctuate in that station, which may affect the macroinvertebrate community.

4.2.2 Macroinvertebrate Community

Both Shibboleth Branch stations were fully supporting the AQL in the fall of 2008 and one (Shibboleth Branch #3) was partially supporting in the spring. Station #3, upstream from Powder Spring Lake, was added to the sample schedule in the spring of 2009. Station #3 was partially supporting while the two lower were again fully supporting in the spring. Shibboleth Branch #3 had an MSCI score of 14 during the spring sample season. Individual metrics showed a less than optimum TR, EPTT, and SDI contributed to the low score. The TR and EPTT were much reduced from the metrics at other test stations and BIOREF streams. The BI was slightly outside the optimum range at Shibboleth Branch #2 and #1 in the fall, however, the community was not affected. In the spring, all Shibboleth Branch stations were within or close to the BI suggesting that organic influences probably did not influence the macroinvertebrate community composition. Shibboleth Branch #3 and #2 will be sampled again in the fall of 2009.

4.2.3 Water Quality

Shibboleth Branch water quality was relatively unremarkable with a few exceptions. Nutrients and chlorides were detected in low concentrations during both seasons. Less than optimum BIs at Shibboleth Branch #2 and #1 in the fall and Shibboleth Branch #1 in the spring may be evidence that organics are available but not enough to influence the community composition.

Dissolved metals were detected in water samples from Shibboleth Branch. Dissolved barium was found above reference levels at all stations sampled in both seasons. Dissolved lead was detected in low levels in the spring at all Shibboleth Branch stations, including Shibboleth Branch #3. Dissolved nickel was detected at all three stations in the spring. Dissolved zinc was found at Shibboleth Branch #2 in both seasons and #1 in the spring. These constituents were elevated above reference stations suggesting that concentrations may be related to past mining effects. Shibboleth Branch appears to contain constituents associated with barite mining.

4.2.4 Fine Sediment Coverage and Character

Fine sediment coverage was greater in most Shibboleth Branch stations than the mean of controls. Shibboleth Branch #3 was not significantly higher overall in fine sediment when we sampled in the spring, probably due to its gradient and ability to remove fine sediment particles. Fine sediment at Shibboleth Branch #3 was patchy and found in higher percentages (i.e. >90%) in some low flow areas as well as very low in other areas; identifying why the fine sediment was not normally distributed in statistical analyses. However, on September 3, 2009, while conducting a SHAPP at Shibboleth Branch #3, we observed a coating of fine sediment covering most (approximately 70 percent average, using SHAPP methods) of the substrate. This observation suggests that fine sediment coverage may fluctuate at this station. These fluctuations in fine sediment may affect the ability of the stream to support the AQL. The TR and EPTT were much reduced from the metrics at other test stations and BIOREF streams, which may be indicators of fine sediment impairment (Zweig and Rabeni 2001) or heavy metal impairment (Rainbow 1996; Carlisle et al. 1999; Soucek et al 2000; Clements et al. 2000; Poulton et al. 2009c).

The material that remained in the fine sediment at Shibboleth Branch stations was above PECs (MacDonald et al. 2000) for at least two heavy metals. All stations had elevated barium, however, a PEC is not designated for barium. Shibboleth Branch #3 and #2 were above PECs for lead and zinc. Shibboleth Branch #1 was above PECs for cadmium, lead, and zinc.

The sediment coverage and character extended downstream at Shibboleth Branch into WBID 2119. It is possible that the greater coverage of barite mine-related fine sediment that remains at Shibboleth Branch #2 and #1 remains from the Dresser barite dam failure of August 15, 1975, studied by Duchrow (1978). Alternatively, the fine sediment may have deposited during years of mining in the watershed. Regardless, mine-related material was found as a significant portion of the substrate in Shibboleth Branch.

4.3 Potential Bias

The two impaired stations, Pond Creek #2 and Shibboleth Branch #3, are the smallest and most upstream stations on both streams. Comparisons of these two small streams to the much larger BIOREF streams (Meramec River and Huzzah Creek) may not be fair of comparisons. Important comparisons of the MSCI scores of the candidate similar-sized references in this study are not included in this report, however, will be included in the final report. Future results may suggest that these small tributaries are not impaired when compared to similar-sized stream biocriteria. Comparisons of the small test stations to similar-sized references are necessary to have more confidence in the questions: Are the streams impaired, and why?

5.0 Summary

Pond Creek #2 was partially supporting the designated beneficial use AQL during both seasons when compared to the BIOREF streams. Pond Creek #2 was impaired in the fall and spring, with a consistently high BI. Water quality did not obviously support this

contention, as nutrients were not elevated at either Pond Creek station in either season. However, levels may fluctuate. Fine sediment was found in relatively higher coverage at Pond Creek #2; the layer was shallow. The substrate in the small stream was predominantly bedrock, with limited suitable habitat, which may have contributed to the lower scores. Total zinc in the fine sediment was above PECs and may have contributed to its impaired status.

One station in Shibboleth Branch was impaired. Shibboleth Branch #3 was impaired in the spring. A low BI suggested that organics did not play a role in its status. Water quality was relatively unremarkable at all Shibboleth stations, yet identified organic components slightly elevated above the references. However, the levels were not sufficient to cause a change in the BI. Dissolved metals such as barium, lead, nickel, and zinc were found, but were below WQSs in some combination at Shibboleth Branch. With the exception of Shibboleth Branch #3, fine sediment coverage was greater than the controls at all stations, using our relative coverage procedure. Based on the quantity of fine sediment at Shibboleth Branch #3, it does not appear to be the cause for impairment. However, on September 3, 2009, while conducting a SHAPP, we observed a fine sediment coverage that appeared to be much greater than the relative quantity we observed during the earlier fine sediment study. It appears that fine sediment periodically moves through the station and due to gradient is removed. Fine sediment may be related to the impaired status of station #3. The character of the fine sediment at Shibboleth Branch #3 included barium, lead, and zinc above PECs in the fine sediment, which may have also contributed to the impairment at Shibboleth Branch #3.

It appears that Pond Creek and Shibboleth Branch show evidence of mine-related activity. Pond Creek and Shibboleth Branch, both tributaries of Mill Creek, contain dissolved heavy metals in lower concentrations and a relatively high coverage of fine sediment containing metals concentrations above PECs. The metals found in the fine sediment are constituents associated with barite mining; for example barium, cadmium, lead, and zinc. Comparisons with fine sediment taken from candidate reference streams support the suggestion that these constituents are found probably due to mine-related activity.

6.0 Conclusion

The objectives of this project have been met in part. One station on Pond Creek was consistently impaired and one station on Shibboleth Branch was impaired. High BIs at Pond Creek during both seasons indicate organic impairment, while the higher BIs at Shibboleth Branch stations in the fall were not sufficient to alter the community. Dissolved metals associated with barite mining were found in low concentrations, below WQSs. Fine sediment was significantly greater at most Pond Creek and Shibboleth Branch stations than the controls. Several heavy metals were found above PECs in the fine sediments. At this point, it appears that heavy metal-containing fine sediment may play a role in status of the streams.

Most hypotheses were investigated in this preliminary report. 1) Biological metrics were not similar to wadeable/perennial stream biological criteria; 2) Physicochemical water quality was similar, with the exception of dissolved metals detected at the test streams in at least one season, however, not above Water Quality Standards (WQS) of Missouri (MDNR 2005b); 3) The relative coverage of fine sediment was higher at the test streams than the controls and the fine sediment contained heavy metals above PECs; 4) Stream habitat quality was similar between test and control streams.

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Appendix A

Biological and Sediment Assessment Study Plan of Barite Mining Effects on Mill Creek and Mineral Fork Tributaries
Washington, Crawford, Dent, and Iron Counties
August 12, 2008

Missouri Department of Natural Resources
Field Services Division
Environmental Services Program
Water Quality Monitoring Section

August 12, 2008

Biological and Sediment Assessment Study Plan of Barite Mining Effects on Mill Creek and Mineral Fork Tributaries, Washington, Crawford, Dent, and Iron Counties

1.0 Background

The watersheds of Mill Creek and Mineral Fork have been extensively mined for barium in the past. In 1975, the collapse of a barite tailings pond released a significant amount of metals laden fine sediment into Shibboleth Creek, a tributary to Mill Creek (Duchrow 1978) and metal contamination in fish was found by Czarnezki and Trial (1997) in Mill Creek. The long-term impact of tailings and general barite mining on these tributaries is not known.

In the fall of 2005 and spring of 2006, the Environmental Services Program (**ESP**), Water Quality Monitoring Section (**WQMS**) conducted biological assessments on Mill Creek and Mineral Fork, Washington Counties (MDNR 2007a; MDNR 2007b). Mill Creek appeared to have a contribution of dissolved barium from watershed runoff. Mineral Fork had relatively high level of dissolved barium concentrations in the water, and a continuous low level of chloride; indicators of human wastewater influence or mine related activity.

The results of MDNR studies (2007a; 2007b) recommended that biological assessments and fine sediment studies be conducted on the tributaries of Mill Creek and Mineral Fork, Washington County. Specifically, biological assessments and fine sediment studies will be conducted on Mill Creek tributaries such as Fountain Farm Branch, Pond Creek, and Shibboleth Branch and Mineral Fork tributaries such as Old Mines Creek, Salt Pines Creek and an unnamed tributary.

2.0 Objectives

- Assess aquatic life protection designated use status of the macroinvertebrate community

- Document nutrient and dissolved metals levels in the tributaries and assess water quality (MDNR 2005).

- Identify the relative quantity of fine sediment per area; and quantify sediment metals content

- Assess the quality of stream habitat

2.1 Null Hypotheses

5. Biological metrics and Macroinvertebrate Stream Condition Index (**MSCI**) scores will be similar between test and control streams; as well as wadeable/perennial stream biological criteria.

6. Physicochemical water quality will be similar at all stations and parameters will meet the Water Quality Standards (**WQS**) of Missouri (MDNR 2005b).

7. The relative percent coverage of fine sediment observed in test streams will be similar to that of control streams.

8. Stream habitat quality will be similar between tributaries.

3.0 Study Design

The study area, biological assessment, fine sediment study, and stream habitat assessment are described below.

3.1 Study Area

The tributaries of Mill Creek, and Old Mines Creek, itself a tributary to Mineral Fork and the control streams are shown in Figure 1 and described in Table 1. Thirteen stations are allocated to this project. Seven stations will be used for the Mill Creek and Mineral Fork tributaries. Mill Creek tributaries stations include two on Shibboleth Branch, one on Fountain Farm Branch and two on Pond Creek. Mineral Fork or more specifically Old Mines Creek tributary stations include a tributary to Old Mines and Salt

Pines Creek. All streams are located in the Ozark/Meramec Ecological Drainage Unit (**EDU**).

Reference streams are listed in Table 1. All of the classified control streams have similar 5-parameter valley segment types (**VST**) relative to the majority of test streams with the exception of gradient. Most test streams were high gradient, whereas several of the controls are medium gradient. References/controls stations were also selected by having no known outfall or mining influence upstream in their watershed.

3.2 Biological Assessment

A biological assessment consists of macroinvertebrate community and physicochemical water evaluation.

3.2.1 Macroinvertebrate Sampling and Analyses

As specified in the Semi-quantitative Macroinvertebrate Stream Bioassessment Project Procedure (**SMSBPP,** MDNR 2003d), macroinvertebrates will be sampled from three specific habitats. These target habitats are based on stream type (MDNR 2003d). The tributaries are considered riffle/pool dominant streams in which flowing water over coarse substrate, non-flowing water over depositional substrate and rootmat habitats will be sampled. Macroinvertebrates will be subsampled according to the SMSBPP and identified to specific taxonomic levels (MNDR 2005a) in order to calculate metrics in a standardized fashion (MDNR 2003d; MDNR 2005a).

Macroinvertebrate community data will be analyzed using three strategies. Macroinvertebrate Stream Condition Index scores, individual biological criteria metrics, and dominant macroinvertebrate families will be examined and compared between test and reference streams.

3.2.2 Data Recording and Analyses

Macroinvertebrate data will be entered in a Microsoft Access database in accordance with Quality Control Procedures for Data Processing, MDNR-WQMS-214 (MDNR 2003b). Data analysis is automated within the Access database. A total of four standard metrics will be calculated for each sample reach according to the SMSBPP: Taxa Richness (TR); Ephemeroptera,

Plecoptera, Trichoptera Taxa (EPTT); Biotic Index (BI); and the Shannon Diversity Index (SDI).

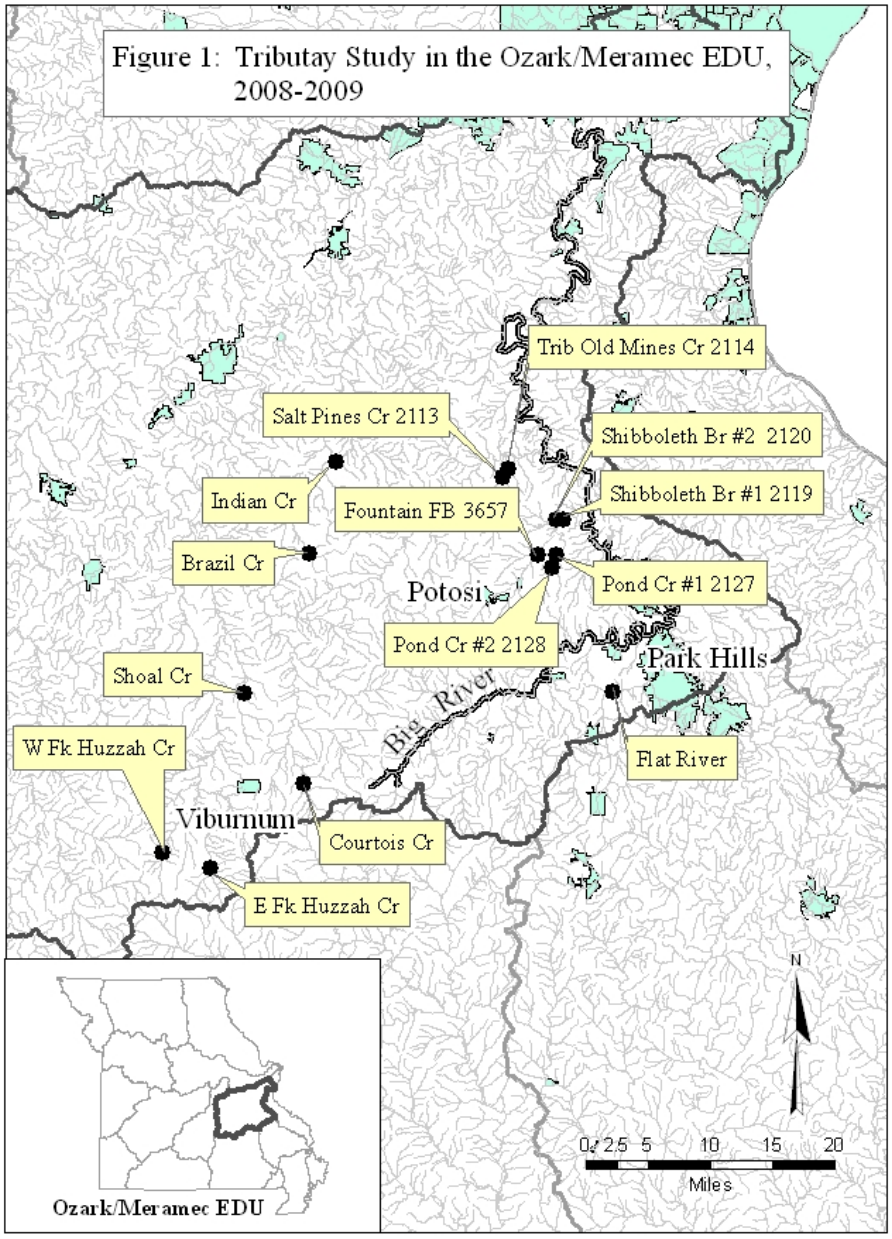


Table 1 Sampling Station Location

Station	County	Location	Description; WBID	Purpose
Trib. Old Mines Cr	Washington	NW Sec. 30; T. 39N., R3E E698562 N4216811	North/Downstream of MO Hwy 21; 2114	Test
Salt Pines Creek	Washington	NE Sec. 31; T. 39NR3E E697830 N4215928	North/Downstream of MO Hwy 21; 2113	Test
Shibboleth Branch #2	Washington	NW Sec. 14; T. 38N., R3E. E704807 N4210506	End Johnson Road; 2120	Test
Shibboleth Branch #1	Washington	NW Sec. 13; T. 38N.,R.3E. E705671 N4210490	Bridge Johnson Road; 2119	Test
Pond Creek #2	Washington	NE Sec.3; T. 37N.,R.3E. E703719 N4203308	Downstream Pond Creek Road; 2128	Test
Pond Creek #1	Washington	NW Sec. 35; T.38N.,R.3E. E704868 N4205941	Upstream confluence with Mill Creek; 2127	Test
Fountain Farm Br #1	Washington	NE Sec. 33; T.38N.,R.3E. E702139 N4205858	Upstream confluence with Mill Creek; 3657	Test
Brazil Creek	Washington	NE Sec. 28; T.38N.,R1W. E672696 N4206120	USFS-Brazil Creek Campground	Control
Shoal Creek	Crawford	NW Sec. 22; T.36.N.,R2W E663955 N4187505	USFS -Big Shoal Cr. Rd. ca.3 miles NE Davisville	Control
Indian Creek	Washington	SW Sec. 24; T.39.N.,R. 1W. E676305 N4217749	Downstream MO Hwy 185	Alternate Control
West Fork Huzzah Creek	Dent	SW Sec. 15; T.34 N.,R.3 W. E653573 N4166719	USFS-Downstream MO Hwy 32 at Howes Mill, MO	Control
East Fork Huzzah Creek	Dent	SW Sec. 20; T.34.N.,R.2 W. E659956 N4164882	Downstream LWB app. 2mi S on AC at Boss, MO	Control
Flat River	St. Francois	SW Sec. 21. T. 36N.,R. 4E. E710789 N4187399	Downstream Old Irondale Road	Alternate Control
Courtois Creek	Iron	SW Sec. 28; T. 35N.,R. 1W. E672115 N4175783	Downstream CR80A @ Goodwater, MO	Control

LWB = low-water bridge; CR = county road; MO = Missouri; USFS= US Forest Service

4.0 Physicochemical Water Sampling and Analyses

Physicochemical water samples were handled according to the appropriate MDNR, Standard Operating Procedure (**SOP**) and/or Project Procedure (**PP**) for sampling and analyzing physicochemical water samples. Results for physicochemical water parameters will be examined by season and station.

Fall 2008 and spring 2009 physicochemical water samples will either be measured *in-situ* or collected as grab samples and analyzed at the Environmental Services Program laboratory. Temperature (C^o), pH, conductivity (uS), dissolved oxygen (mg/L), and discharge in cubic feet per second (**cfs**) will be measured *in-situ*. Grab samples will be collected and handled according to the SOP MDNR-FSS-001 Required/Recommended Containers, Volumes, Preservatives, Holding Times, and Special Sampling Considerations (MDNR 2003c). All samples will be kept on ice during transport to ESP. Turbidity samples (NTU) will be measured and recorded in the WQMS biology laboratory. The ESP, Chemical Analysis Section (**CAS**) will conduct analyses for hardness (mg/L), ammonia-nitrogen (mg/L), nitrate+nitrite-nitrogen (mg/L), total nitrogen (mg/L), chloride (mg/L), total phosphorus (mg/L), and dissolved metals. Dissolved metals samples will include barium, cadmium, calcium, cobalt, copper, lead, magnesium, nickel, and zinc. Samples for metals will be filtered in the field.

Physicochemical results will be compared between stations from upstream to downstream, as well as with Missouri's WQS (MDNR 2005b). Interpretation of acceptable limits in the WQS may be dependent on a stream's classification and its beneficial-use designation (MDNR 2005b). The majority of tributaries are class "C" streams with designated uses for AQL, LWW, and WBC-category B. Furthermore, acceptable limits for some parameters, such as dissolved metals, may be dependent on the rate of exposure. These exposure or toxicity limits are based on the lethality of a toxicant given long-term exposure (chronic toxicity, **c**) or short-term exposure (acute toxicity, **a**).

4.1 Discharge

Stream flow will be measured at each station using a Marsh-McBirney Flowmate™ flow meter. Velocity and depth measurements will be recorded at each station according to SOP MDNR-WQMS-113 Flow Measurement in Open Channels (MDNR 2003a).

4.2 Data Reporting

Water quality data will be entered in the Laboratory Information Management System (LIMS) database. Results of the study will be summarized and interpreted in report format.

5.0 Fine Sediment

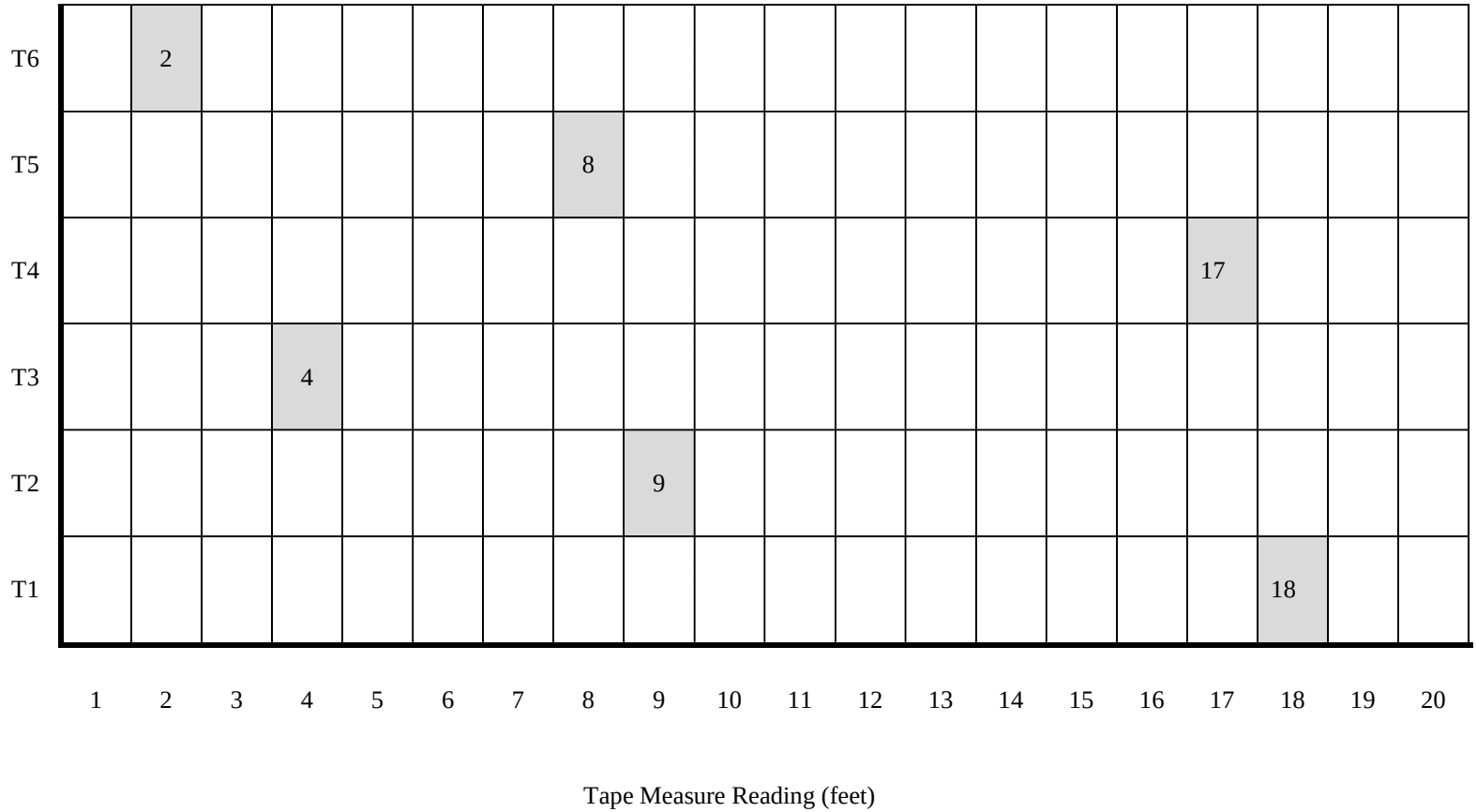
In-stream deposits of fine sediment (e.g. particle size ca. <2 mm) will be estimated for percent coverage and characterized for composition of total recoverable metals (**TR**, ug/kg). This will be done once in September 2008.

5.1 Fine Sediment Percent Coverage

The relative percentage of fine sediment will be estimated and characterized for each station. Each sampling station will contain three sediment estimation areas called **grids**. In order to ensure sampling method uniformity, grids will be located between the downstream margin of a riffle or run and the upstream margin of a pool. Depths of the sample areas will not exceed two (2.0) feet and water velocity will be less than 0.5 feet per second (fps). A Marsh McBirney flow meter will be used to ensure that water velocity of the sample area will be within this range.

The percentage of fine sediment will be estimated at each station by constructing a virtual grid of potential **quadrats** (Figure 2). A tape measure will be anchored from bank to bank that comprises the downstream edge of each grid. Each grid consists of six contiguous transects that traverse the stream. One sample quadrat (ca. 10” x 10”) will be randomly placed directly on the substrate within each of the six transects. Placement of the quadrat within each transect will be determined by using a random number that equates to one foot increments from one bank. The trailing edge of the quadrat will be placed on the downstream transect edge. Two investigators will estimate the percentage of the stream bottom that consists of fine sediment sized particles within each quadrat. The estimates will be accepted if the two observations are within a ten percent. If estimates diverged more than ten percent, the investigators will repeat the process until the estimates are within the acceptable margin of error. An average of these two estimates will be recorded and used for analyses.

Figure 2: Grid of transects (T) and quadrats (in gray, numbered) used in estimating percent fine sediment; Example: stream 20' wide; quadrat placement based on random numbers (e.g. 18, 9, 4, 17, 8, and 2).



5.2 Fine Sediment Metals Characterization

Fine sediment will be characterized for metals by determining its content of total recoverable barium, lead, cadmium, and zinc (ug/kg). One composite sample of the fine sediment will be collected at each grid for a total of three samples per station. Each composite consists of three (3) two-ounce samples of fine sediment sized particles that will be dredged from the substrate and placed into an eight ounce clear glass jar.

Dredging will not exceed a depth of two inches. The lid of the two-ounce jar will be used to retain the fine sediment while retrieving the sample through the water column. If fine sediment is not found in sufficient quantities within the grid, a representative composite collection will be taken from an area near the study grid. Samples will be kept on ice and delivered to the ESP CAS in Jefferson City, Missouri for analyses.

5.3 Fine Sediment Data Analyses

Statistical analyses of the percentage of fine sediment found in the substrate will be conducted using Sigmastat Version 3.5 (2006). Kruskal-Wallis One-way Analysis of Variance on ranks (ANOVA on ranks) will be used to determine significant differences between sample stations. If significant differences ($p<0.05$) are detected between stations, an All Pair-wise Multiple Comparison Procedure Tukey Test will be conducted to identify where differences ($p<0.05$) are found. Each station's data ($n=18$ quadrats) will be included in the comparison between stations. Two hundred thirty four quadrat observations will be included for the 13 sample tributaries.

Statistical analyses for metals content (character) between stations will also be conducted using Kruskal-Wallis ANOVA on ranks. Since each station consists of three composite samples, each stations' data ($n=9$) will be used in the analysis. Significant differences ($P<0.05$) will be identified as before. Dunn's test or other comparison procedures may be used to determine where differences occur.

6.0 Quality Control

Quality control will be used as stated in the MDNR Standard Operating Procedures and Project Procedures.

7.0 Stream Habitat Assessment

Stream habitat will be assessed as outlined in the Stream Habitat Assessment Project Procedure (**SHAPP**) for Riffle/Pool prevalent streams (MDNR 2003d). The SHAPP assesses the quality of the stream habitat and the potential influence habitat might have on the aquatic biological community. Stream habitat quality is scored for each station and the test scores are compared with mean SHAPP reference station scores. Stream habitat scores will also be compared between tributaries.

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Appendix B

Macroinvertebrate Bench Sheet Report for Tributary Stations
Fall 2008 and Spring 2009
(* Does not include spring 2009 candidate reference bench sheets)

Aquid Invertebrate Database Bench Sheet Report
Pond Cr [0804107], Station #2, Sample Date: 9/24/2008 2:20:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
"HYDRACARINA"			
Acarina	1	16	1
AMPHIPODA			
Gammarus	4		9
COLEOPTERA			
Dubiraphia	1	13	92
Ectopria nervosa	3	1	
Optioservus sandersoni	1		4
Psephenus herricki	1		
Stenelmis	1		
DECAPODA			
Orconectes medius	2		
Orconectes punctimanus		-99	
Orconectes virilis			-99
DIPTERA			
Ablabesmyia		3	3
Ceratopogoninae		4	2
Chironomidae	2		2
Chrysops			1
Coelotanypus			2
Corynoneura	1	1	
Cricotopus bicinctus		1	1
Cricotopus/Orthocladius	16	2	
Cryptochironomus		1	
Dicrotendipes		1	
Ephydridae		-99	
Epoicocladius	1		
Forcipomyiinae	1		
Hemerodromia	3		23
Labrundinia		2	1
Micropsectra		1	
Microtendipes		6	1
Natarsia	1		
Parakiefferiella	2	8	
Paralauterborniella			1
Parametriocnemus	1		
Paratanytarsus			4
Paratendipes	1		
Phaenopsectra		2	3
Polypedilum aviceps	3		

Aquid Invertebrate Database Bench Sheet Report
Pond Cr [0804107], Station #2, Sample Date: 9/24/2008 2:20:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Polypedilum illinoense grp	2	1	4
Polypedilum scalaenum grp	1		
Rheotanytarsus	17	1	
Simulium	9		
Stempellinella	20	11	1
Tanytarsus	7	22	4
Thienemanniella	6		1
Thienemannimyia grp.	3	1	4
Tipulidae	3	1	
Tribelos	3	14	1
EPHEMEROPTERA			
Baetis	4		
Caenis anceps	2		
Caenis latipennis	193	171	63
Ephemera simulans	9	1	1
Eurylophella	1	1	4
Heptageniidae	16	4	
Hexagenia limbata			2
Isonychia bicolor	14		
Leptophlebiidae		1	2
Maccaffertium pulchellum	24		
Stenacron	21		
Stenonema femoratum		1	
HEMIPTERA			
Microvelia	1		1
Rhagovelia	-99		2
ISOPODA			
Caecidotea	12	2	15
LEPIDOPTERA			
Petrophila	1		
LUMBRICINA			
Lumbricina	5		
MEGALOPTERA			
Corydalus	1		
Nigronia serricornis	3		
Sialis		-99	1
ODONATA			
Argia	8	1	3
Calopteryx			9
Gomphidae	1		

Aquid Invertebrate Database Bench Sheet Report
Pond Cr [0804107], Station #2, Sample Date: 9/24/2008 2:20:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Hagenius brevistylus		5	2
TRICHOPTERA			
Cheumatopsyche	24	1	
Hydropsyche	8		
Limnephilidae		1	3
Oecetis			4
Polycentropus	3		2
Triaenodes			11
TUBIFICIDA			
Aulodrilus	1	2	1
Tubificidae	10	18	1
VENEROIDA			
Pisidiidae	1	4	4

Aquid Invertebrate Database Bench Sheet Report
Pond Cr [0804105], Station #1, Sample Date: 9/24/2008 10:40:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
"HYDRACARINA"			
Acarina	15	7	17
AMPHIPODA			
Gammarus		-99	1
Hyalella azteca			24
BRANCHIOBDELLIDA			
Branchiobdellida	6		3
COLEOPTERA			
Dubiraphia		80	30
Ectopria nervosa	1		1
Helichus lithophilus			2
Heterosternuta			1
Microcylloepus pusillus			5
Optioservus sandersoni	35	1	1
Psephenus herricki	15	7	
Stenelmis	9	1	18
DECAPODA			
Orconectes		1	
Orconectes hylas	1		2
Orconectes luteus	1		
Orconectes medius	5	1	
Orconectes punctimanus			1
DIPTERA			
Ablabesmyia		2	2
Caloparyphus		1	
Ceratopogoninae		2	6
Cladotanytarsus		1	
Corynoneura	2		2
Cricotopus bicinctus	1		2
Cricotopus/Orthocladius	9	1	2
Cryptochironomus		2	
Hemerodromia	4		2
Labrundinia		2	6
Nanocladius		1	
Natarsia		3	
Parakiefferiella		9	
Parametriocnemus	2		2
Paratanytarsus			6
Phaenopsectra			1
Polypedilum convictum	3		

Aquid Invertebrate Database Bench Sheet Report
Pond Cr [0804105], Station #1, Sample Date: 9/24/2008 10:40:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Polypedilum illinoense grp			6
Pseudochironomus		2	
Rheocricotopus			2
Rheotanytarsus	14		6
Simulium	28		8
Stempellina		1	
Stempellinella	1	14	
Stenochironomus	1		
Tabanus	3	1	
Tanytarsus	2	8	2
Thienemanniella	3		
Thienemannimyia grp.		1	2
Tipula	1		
Tipulidae			2
Tribelos		3	
EPHEMEROPTERA			
Acentrella	4		
Baetis	17		
Baetisca lacustris		1	
Caenis anceps	17	52	3
Caenis latipennis	20	30	24
Centroptilum		3	2
Ephemera		1	
Eurylophella	17	23	39
Heptageniidae	56	1	1
Isonychia bicolor	68		1
Leptophlebiidae		8	3
Maccaffertium mediopunctatum	15		
Maccaffertium pulchellum	47		1
Procloeon			2
Stenacron	8	9	
Stenonema femoratum		16	1
Tricorythodes	5		
HEMIPTERA			
Metrobates			2
Microvelia			2
ISOPODA			
Caecidotea	1	1	8
LEPIDOPTERA			
Petrophila	1	1	
LIMNOPHILA			

Aquid Invertebrate Database Bench Sheet Report
Pond Cr [0804105], Station #1, Sample Date: 9/24/2008 10:40:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Fossaria		1	
Laevapex	1		
Menetus			1
LUMBRICINA			
Lumbricina	8		1
MEGALOPTERA			
Corydalus	5		1
Nigronia serricornis	6	1	
Sialis		1	
MESOGASTROPODA			
Elimia	6		1
ODONATA			
Argia	6	6	12
Calopteryx			3
Enallagma			8
Gomphus			2
Hagenius brevistylus		1	
Hetaerina			1
Macromia		-99	-99
Stylogomphus albistylus	71	3	1
PLECOPTERA			
Acroneuria	2		
Chloroperlidae	1		
Leuctra	2		
TRICHOPTERA			
Ceratopsyche morosa grp	6		
Cheumatopsyche	54		11
Chimarra	7		7
Helicopsyche	2	2	1
Hydropsyche			2
Leptoceridae		1	
Limnephilidae		1	
Oecetis		1	2
Polycentropus	4		4
Psychomyia	1		
Triaenodes			3
TRICLADIDA			
Planariidae	9		
TUBIFICIDA			
Aulodrilus		2	

Aquid Invertebrate Database Bench Sheet Report
Pond Cr [0804105], Station #1, Sample Date: 9/24/2008 10:40:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Enchytraeidae	1		
Tubificidae		5	
VENEROIDA			
Pisidiidae		4	

Aquid Invertebrate Database Bench Sheet Report
Shibboleth Br [0804109], Station #2, Sample Date: 9/24/2008 12:30:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
"HYDRACARINA"			
Acarina	6	9	8
COLEOPTERA			
Dubiraphia		14	24
Ectopria nervosa	1		
Lutrochus	1		
Macronychus glabratus			6
Microcylloepus pusillus	5		
Optioservus sandersoni	15	1	2
Psephenus herricki	1		
Stenelmis	6		15
DECAPODA			
Orconectes		1	
Orconectes harrisonii	-99	-99	
Orconectes luteus		-99	
Orconectes medius	-99	-99	
Orconectes punctimanus			-99
DIPTERA			
Ablabesmyia			1
Cardiocladius	4		
Ceratopogoninae	1	3	2
Chironomidae	2		
Cladotanytarsus			1
Clinotanypus			2
Corynoneura	1		1
Cricotopus bicinctus			5
Cricotopus/Orthocladius	19	3	
Dicrotendipes			1
Eukiefferiella	4		
Hemerodromia	7	2	4
Labrundinia			2
Microtendipes		1	1
Parakiefferiella		1	4
Parametriocnemus	9		
Paraphaenocladius		1	
Paratanytarsus		1	9
Phaenopsectra		5	2
Polypedilum convictum	14	1	
Polypedilum halterale grp			1
Polypedilum illinoense grp		4	3

Aquid Invertebrate Database Bench Sheet Report
Shibboleth Br [0804109], Station #2, Sample Date: 9/24/2008 12:30:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Rheocricotopus	8		
Rheotanytarsus	10		4
Simulium	79		2
Stempellinella	23	24	6
Stenochironomus			1
Tanytarsus	5	10	10
Thienemanniella	1	8	2
Thienemannimyia grp.	2		1
Tipulidae	1		
Zavrelimyia		1	2
EPHEMEROPTERA			
Acentrella	1		
Baetis	21		1
Caenis anceps	16	9	1
Caenis latipennis	58	142	54
Callibaetis			1
Ephemera	2	3	
Eurylophella	3	2	5
Heptageniidae	8	5	1
Hexagenia			5
Isonychia bicolor	93		
Leptophlebiidae	1	1	4
Maccaffertium mediopunctatum	3		
Maccaffertium pulchellum	27	4	
Stenacron	6	13	
Stenonema femoratum		7	
Tricorythodes			2
ISOPODA			
Caecidotea	108	9	41
LEPIDOPTERA			
Petrophila	1		
LIMNOPHILA			
Ancylidae	1		
Fossaria		1	
Menetus			4
LUMBRICINA			
Lumbricina	2		
MEGALOPTERA			
Corydalus	2		
Nigronia serricornis	4		

Aquid Invertebrate Database Bench Sheet Report
Shibboleth Br [0804109], Station #2, Sample Date: 9/24/2008 12:30:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Sialis		-99	
ODONATA			
Argia	4	3	6
Calopteryx	1	-99	3
Enallagma			7
Gomphus			-99
Hagenius brevistylus		2	3
Macromia		-99	
Stylogomphus albistylus	2	2	
PLECOPTERA			
Acroneuria	1		
TRICHOPTERA			
Ceratopsyche morosa grp	1		
Cheumatopsyche	40		2
Chimarra	59		
Limnephilidae			9
Oecetis			6
Polycentropus			3
Pycnopsyche			1
Triaenodes		1	11
TRICLADIDA			
Planariidae	4		1
TUBIFICIDA			
Branchiura sowerbyi		1	
Tubificidae		8	
VENEROIDA			
Pisidiidae	2		

Aquid Invertebrate Database Bench Sheet Report
Shibboleth Br [0804108], Station #1, Sample Date: 9/25/2008 11:00:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
"HYDRACARINA"			
Acarina	6		1
AMPHIPODA			
Hyalella azteca	1	2	11
COLEOPTERA			
Dubiraphia	2	12	34
Ectopria nervosa	1	1	1
Helichus basalis			2
Optioservus sandersoni	4	1	2
Psephenus herricki	3	3	
Stenelmis	25	2	12
DECAPODA			
Orconectes harrisonii			1
Orconectes hylas	1		
Orconectes luteus	-99		
Orconectes medius	-99	-99	
Orconectes punctimanus			-99
DIPTERA			
Ablabesmyia		6	1
Antocha	1		
Ceratopogoninae	1	3	
Chironomus		1	
Cladotanytarsus		2	
Corynoneura		1	1
Cricotopus/Orthocladius	1		
Dicrotendipes	1		
Epoicocladius	1		
Hemerodromia	5	1	
Labrundinia		1	6
Mesosmittia			1
Nanocladius			1
Natarsia		10	
Nilotanypus	1		
Parakiefferiella	2		
Parametriocnemus	8		
Paratanytarsus		1	1
Phaenopsectra		3	1
Polypedilum convictum	1		
Pseudochironomus		2	
Rheotanytarsus	4		

Aquid Invertebrate Database Bench Sheet Report
Shibboleth Br [0804108], Station #1, Sample Date: 9/25/2008 11:00:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Simulium	25		
Stempellinella	12	6	2
Stictochironomus		2	
Stratiomys	-99		
Tabanus	-99		
Tanytarsus	11	6	10
Thienemanniella	7		1
Thienemannimyia grp.	1	1	2
Tribelos		1	
EPHEMEROPTERA			
Baetis	26		
Caenis anceps	21	8	
Caenis latipennis	212	90	93
Ephemera simulans	5	3	
Ephemeridae		3	3
Eurylophella	9	1	4
Heptageniidae	32	3	
Isonychia bicolor	32		-99
Leptophlebiidae	1		13
Maccaffertium mediopunctatum	5		
Maccaffertium pulchellum	30		
Procloeon		4	
Stenacron	7	13	2
Stenonema femoratum	2	3	1
Tricorythodes	13		
HEMIPTERA			
Microvelia			2
Rhagovelia	7		2
Trepobates		1	
ISOPODA			
Caecidotea	54	15	44
Caecidotea (Blind & Unpigmented)		2	
LEPIDOPTERA			
Parapoynx	-99	1	
LIMNOPHILA			
Menetus			1
LUMBRICINA			
Lumbricina	1		
MEGALOPTERA			
Nigronia serricornis	-99		

Aquid Invertebrate Database Bench Sheet Report
Shibboleth Br [0804108], Station #1, Sample Date: 9/25/2008 11:00:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Sialis		1	
ODONATA			
Argia	5	7	6
Enallagma			11
Gomphidae		4	
Hagenius brevistylus			-99
Macromia		1	
Stylogomphus albistylus		1	
PLECOPTERA			
Acroneuria	2		
RHYNCHOBDELLIDA			
Glossiphoniidae	1		
TRICHOPTERA			
Cheumatopsyche	19		
Chimarra	2		
Helicopsyche	4		
Hydropsyche	1		
Limnephilidae			1
Oecetis			4
Polycentropus	4	2	
Triaenodes			13
TRICLADIDA			
Planariidae	1		
TUBIFICIDA			
Branchiura sowerbyi	2	15	
Tubificidae		13	2
VENEROIDA			
Corbicula	1	2	
Pisidiidae	4	1	

Aquid Invertebrate Database Bench Sheet Report
Fountain Farm Br [0804106], Station #1, Sample Date: 9/24/2008 12:30:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
"HYDRACARINA"			
Acarina	7	18	1
AMPHIPODA			
Hyalella azteca		1	28
BRANCHIOBDELLIDA			
Branchiobdellida	1		1
COLEOPTERA			
Berosus		1	
Dubiraphia	7	15	14
Ectopria nervosa	7	20	4
Helichus basalis	2		5
Heterosternuta	1	1	3
Lutrochus	1	2	
Neoporus			1
Optioservus sandersoni	6	3	4
Paracymus			1
Psephenus herricki	1	6	
Stenelmis	9	2	
DECAPODA			
Orconectes hylas		1	
Orconectes luteus			-99
Orconectes medius	7	1	
Orconectes punctimanus		5	-99
Orconectes virilis			-99
DIPTERA			
Ablabesmyia		6	
Atherix	1		
Caloparyphus		2	
Chironomidae			1
Cladotanytarsus	1		1
Corynoneura	1	1	1
Cricotopus/Orthocladius	3	2	2
Dolichopodidae	1		
Eukiefferiella	2		
Forcipomyiinae	1		
Gymnometriocnemus			1
Hemerodromia			1
Labrundinia		1	
Microtendipes	4	2	
Parakiefferiella	1		

Aquid Invertebrate Database Bench Sheet Report
Fountain Farm Br [0804106], Station #1, Sample Date: 9/24/2008 12:30:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Parametriocnemus	2		
Paratanytarsus			1
Phaenopsectra		2	
Polypedilum convictum	4		
Polypedilum illinoense grp			4
Pseudochironomus	3	2	
Rheotanytarsus	5		11
Simulium	103		
Stempellinella	11	10	4
Tabanus	1		
Tanytarsus	4	2	6
Thienemanniella	2		3
Thienemannimyia grp.	3	3	5
Tipulidae	2		
Zavrelimyia		1	
EPHEMEROPTERA			
Baetis	15	2	
Baetisca lacustris		1	
Caenis anceps	69	65	42
Caenis latipennis	118	43	87
Callibaetis			2
Choroterpes		1	
Ephemera simulans		4	
Eurylophella	3	14	21
Isonychia bicolor	11		
Leptophlebiidae	1	6	5
Maccaffertium mediopunctatum	1		
Maccaffertium pulchellum	44	1	2
Stenacron	30	11	1
Stenonema femoratum	12	14	1
Tricorythodes	5		
HEMIPTERA			
Rhagovelia	1		
ISOPODA			
Caecidotea	6	2	9
LIMNOPHILA			
Gyraulus	2		
MEGALOPTERA			
Corydalus	1		
MESOGASTROPODA			

Aquid Invertebrate Database Bench Sheet Report
Fountain Farm Br [0804106], Station #1, Sample Date: 9/24/2008 12:30:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Elimia	2	3	
ODONATA			
Argia	5	5	1
Calopteryx		2	4
Enallagma			2
Gomphidae		5	1
Gomphus	3		
Hagenius brevistylus		2	1
Ischnura			2
Stylogomphus albistylus		1	
PLECOPTERA			
Acroneuria	2		
TRICHOPTERA			
Cheumatopsyche	15		
Chimarra	1		
Helicopsyche	2		
Hydropsyche	2		1
Limnephilidae	1		
Triaenodes			4
TUBIFICIDA			
Enchytraeidae	2	1	
Tubificidae	1		
VENEROIDA			
Pisidiidae	2		

Aquid Invertebrate Database Bench Sheet Report
Salt Pines Cr [0804103], Station #1, Sample Date: 9/23/2008 11:40:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
"HYDRACARINA"			
Acarina	2	4	1
BRANCHIOBDELLIDA			
Branchiobdellida	2		3
COLEOPTERA			
Dubiraphia	1	13	58
Ectopria nervosa	1	3	
Heterosternuta	2		
Optioservus sandersoni	5		1
Psephenus herricki	5		1
Stenelmis	8	1	1
DECAPODA			
Orconectes hylas	7	2	
Orconectes medius	2		
Orconectes punctimanus	-99		
DIPTERA			
Chironomidae	1		2
Corynoneura		6	9
Cricotopus/Orthocladius	2		1
Diptera			1
Eukiefferiella	3		1
Labrundinia		1	
Nilotanypus			1
Parametriocnemus	7		
Paratanytarsus			1
Phaenopsectra			1
Polypedilum convictum	3		
Polypedilum illinoense grp	2	1	2
Polypedilum scalaenum grp			1
Rheocricotopus			2
Rheotanytarsus	5	1	10
Simulium	9		6
Stempellinella	5		1
Tabanus	1		
Tanytarsus	3		1
Thienemanniella	6		7
Thienemannimyia grp.	2		1
Tipulidae		1	
Zavrelimyia		3	
EPHEMEROPTERA			

Aquid Invertebrate Database Bench Sheet Report
Salt Pines Cr [0804103], Station #1, Sample Date: 9/23/2008 11:40:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Baetis	17		1
Caenis anceps		1	
Caenis latipennis	47	130	72
Choroterpes		1	
Ephemeridae		1	
Eurylophella	1	5	51
Heptageniidae	22	2	2
Isonychia bicolor	10		
Leptophlebiidae	1	5	8
Maccaffertium pulchellum	10		
Procloeon		1	
Stenacron	8	14	1
Stenonema femoratum	3	13	
HEMIPTERA			
Microvelia			1
Ranatra kirkaldyi			1
Rhagovelia			1
ISOPODA			
Caecidotea	386	77	58
LIMNOPHILA			
Physella			1
LUMBRICINA			
Lumbricina	-99		
MEGALOPTERA			
Chauliodes			1
ODONATA			
Argia		1	
Calopteryx	1	3	3
Enallagma		1	5
Gomphidae	3		
Stylogomphus albistylus		1	
PLECOPTERA			
Acroneuria	7	2	
TRICHOPTERA			
Cheumatopsyche	8		1
Chimarra	8		2
Helicopsyche		1	
Hydropsyche	1		
Polycentropodidae	1		
Triaenodes			2

Aquid Invertebrate Database Bench Sheet Report
Salt Pines Cr [0804103], Station #1, Sample Date: 9/23/2008 11:40:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
TRICLADIDA			
Planariidae	2		
TUBIFICIDA			
Spirosperma	1		
Tubificidae	4	2	

Aquid Invertebrate Database Bench Sheet Report
Trib. Old Mines Cr [0804102], Station #1, Sample Date: 9/23/2008 10:30:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
"HYDRACARINA"			
Acarina	2	13	
AMPHIPODA			
Gammarus	10	3	11
COLEOPTERA			
Dubiraphia		1	41
Dytiscidae		1	
Ectopria nervosa	11	5	
Hydrobius	1		
Scirtidae			2
Stenelmis	8	9	1
DECAPODA			
Orconectes medius	-99		
DIPTERA			
Ablabesmyia		5	1
Ceratopogoninae		1	1
Cricotopus/Orthocladius	1		
Dicrotendipes			1
Diptera	1	1	
Eukiefferiella	1		
Forcipomyiinae		1	
Hemerodromia	11		2
Hexatoma		1	1
Labrundinia		1	
Natarsia		4	
Nemotelus	1		
Nilotanypus			1
Parametriocnemus	12		
Paratanytarsus			2
Polypedilum convictum	16		
Pseudolimnophila		1	
Rheocricotopus	5		
Rheotanytarsus	6		
Simulium	30	1	
Stempellinella		5	
Tanytarsus	2	4	5
Thienemanniella	4		
Thienemannimyia grp.	2		1
Tipulidae	5		
Zavrelimyia		2	1

Aquid Invertebrate Database Bench Sheet Report
Trib. Old Mines Cr [0804102], Station #1, Sample Date: 9/23/2008 10:30:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
EPHEMEROPTERA			
Acerpenna			1
Baetis	19		
Caenis latipennis	15	129	51
Eurylophella	2	2	
Heptageniidae	11		
Isonychia bicolor	3		
Leptophlebiidae	1	2	1
Maccaffertium pulchellum	12		
Procloeon		3	
Stenacron	5	5	
Stenonema femoratum	5	27	1
Tricorythodes	2		
HEMIPTERA			
Microvelia	1		
ISOPODA			
Caecidotea	102	29	141
LIMNOPHILA			
Lymnaeidae		-99	
LUMBRICINA			
Lumbricina	1		
MEGALOPTERA			
Corydalus	1		
Nigronia serricornis	18		1
MESOGASTROPODA			
Elimia	12	4	2
Pomatiopsis lapidaria	1		
ODONATA			
Argia	8		1
Calopteryx	1	2	15
Gomphidae	35	1	
PLECOPTERA			
Acroneuria	-99		
Leuctridae	1	1	
TRICHOPTERA			
Cheumatopsyche	111		
Chimarra	130		
Polycentropus	4	1	1
TUBIFICIDA			
Enchytraeidae	2		

Aquid Invertebrate Database Bench Sheet Report
Trib. Old Mines Cr [0804102], Station #1, Sample Date: 9/23/2008 10:30:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
VENEROIDA			
Pisidiidae		2	

Aquid Invertebrate Database Bench Sheet Report
Brazil Cr [0804104], Station #1, Sample Date: 9/23/2008 2:20:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
"HYDRACARINA"			
Acarina	6	24	1
COLEOPTERA			
Dubiraphia		4	14
Ectopria nervosa	1		
Hydrobius			1
Optioservus sandersoni	108	10	
Psephenus herricki	23	5	
Stenelmis	5	3	2
DECAPODA			
Orconectes luteus			-99
Orconectes medius	-99		-99
Orconectes punctimanus			-99
Orconectes virilis			-99
DIPTERA			
Ablabesmyia		1	3
Antocha	1		
Atherix	-99		
Ceratopogoninae		2	
Chironomidae	1		
Cricotopus/Orthocladius	2		
Eukiefferiella	4		
Hemerodromia	1		3
Micropsectra		4	1
Microtendipes		1	4
Parametriocnemus	7	1	1
Paraphaenocladius			1
Paratanytarsus			9
Polypedilum aviceps	5	1	
Rheocricotopus		1	
Rheotanytarsus	3		3
Simulium	4		
Stempellinella	1	3	4
Tabanus	1		
Tanytarsus	2	4	
Thienemannimyia grp.	3		14
Tipula	1		
Zavrelimyia		2	1
EPHEMEROPTERA			
Baetis	2		

Aquid Invertebrate Database Bench Sheet Report
Brazil Cr [0804104], Station #1, Sample Date: 9/23/2008 2:20:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Caenis anceps	4	1	
Caenis latipennis	4	29	25
Ephemerella	1		
Eurylophella	274	148	49
Heptageniidae	25		
Isonychia bicolor	22		
Leptophlebiidae	4	57	72
Maccaffertium pulchellum	80	1	
Stenacron	8	44	
Stenonema femoratum	-99	1	
Tricorythodes		1	
HEMIPTERA			
Microvelia			1
Rhagovelia	1		
ISOPODA			
Caecidotea			45
LIMNOPHILA			
Menetus			7
Physella			1
LUMBRICINA			
Lumbricina	-99	1	
MEGALOPTERA			
Nigronia serricornis	2		
MESOGASTROPODA			
Elimia	4	1	3
ODONATA			
Calopteryx			3
Hagenius brevistylus		1	
Hetaerina			1
Stylogomphus albistylus	10	2	4
PLECOPTERA			
Leuctra	1	1	2
TRICHOPTERA			
Cheumatopsyche	104		
Chimarra	4		
Polycentropus	1		1
Triaenodes		1	4
TRICLADIDA			
Planariidae	1		

Aquid Invertebrate Database Bench Sheet Report
Courtois Cr [0804111], Station #1a, Sample Date: 9/30/2008 11:30:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
"HYDRACARINA"			
Acarina	7	9	1
AMPHIPODA			
Gammarus	19	3	6
Stygobromus		3	
BRANCHIOBDELLIDA			
Branchiobdellida	1		
COLEOPTERA			
Desmopachria			1
Dubiraphia			4
Ectopria nervosa	1	1	1
Optioservus sandersoni	126	40	4
Psephenus herricki	26	24	-99
Sperchopsis			1
Stenelmis	11	1	
DECAPODA			
Orconectes luteus	-99	-99	
Orconectes medius	1		-99
Orconectes punctimanus			-99
DIPTERA			
Antocha	1		
Ceratopogoninae		1	
Cladotanytarsus		1	
Cricotopus/Orthocladius	9	2	4
Cryptochironomus		1	
Dicrotendipes		1	
Eukiefferiella	5		1
Hemerodromia	1		1
Labrundinia			1
Micropsectra			1
Microtendipes			1
Natarsia		3	1
Nilotanypus		1	
Parakiefferiella	1	1	
Parametriocnemus	8		
Paratanytarsus			1
Polypedilum aviceps	3		
Polypedilum convictum	1		
Potthastia	4		
Rheocricotopus	3		

Aquid Invertebrate Database Bench Sheet Report
Courtois Cr [0804111], Station #1a, Sample Date: 9/30/2008 11:30:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Rheotanytarsus	3		3
Simulium	30		
Stempellinella		1	1
Tabanus	-99	-99	
Tanytarsus	2	1	
Thienemanniella		1	
Thienemannimyia grp.	1	2	1
Tipula	1		
Tribelos		2	
Zavrelimyia		1	
EPHEMEROPTERA			
Acentrella	21		
Baetis	34		
Caenis latipennis	3	10	13
Ephemerella	1		
Eurylophella	73	103	61
Heptageniidae	13	14	
Isonychia bicolor	20		
Leptophlebiidae		10	
Maccaffertium pulchellum	8	1	
Stenacron	6	18	1
Stenonema femoratum			1
HEMIPTERA			
Microvelia			1
LIMNOPHILA			
Ancylidae			1
Physella		-99	4
LUMBRICINA			
Lumbricina	1	1	
LUMBRICULIDA			
Lumbriculidae	1		
MEGALOPTERA			
Corydalus	-99		
Nigronia serricornis	4	1	
MESOGASTROPODA			
Elimia	5	18	147
ODONATA			
Calopteryx			5
Gomphidae	6	3	
PLECOPTERA			

Aquid Invertebrate Database Bench Sheet Report
Courtois Cr [0804111], Station #1a, Sample Date: 9/30/2008 11:30:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Acroneuria	-99		
Chloroperlidae		3	
Zealeuctra	1		
TRICHOPTERA			
Cheumatopsyche	78		
Chimarra	5		
Helicopsyche	10	11	9
Mystacides		3	1
Oecetis			1
Polycentropus	8	6	3
Triaenodes			7
TRICLADIDA			
Planariidae	4		1
VENEROIDA			
Pisidiidae		2	

Aquid Invertebrate Database Bench Sheet Report
Courtois Cr [0804112], Station #1b, Sample Date: 9/30/2008 11:30:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
"HYDRACARINA"			
Acarina	17	4	2
AMPHIPODA			
Gammarus	11	3	4
BRANCHIOBDELLIDA			
Branchiobdellida	5		
COLEOPTERA			
Dubiraphia			6
Ectopria nervosa		3	-99
Helichus striatus			-99
Optioservus sandersoni	176	51	2
Psephenus herricki	24	10	-99
Stenelmis	17	2	
DECAPODA			
Orconectes luteus			1
Orconectes medius	3		-99
Orconectes punctimanus		-99	1
DIPTERA			
Ablabesmyia			2
Ceratopogoninae		1	
Chironomidae	2	1	2
Cricotopus/Orthocladius	21		6
Eukiefferiella	8		1
Forcipomyiinae			1
Hemerodromia	3		1
Hexatoma	1		
Labrundinia			2
Micropsectra			1
Microtendipes			3
Natarsia			2
Nilotanypus	1		
Parametriocnemus	6	1	
Polypedilum aviceps	6		
Polypedilum convictum	1		
Potthastia	1		
Rheocricotopus	2		
Rheotanytarsus	8		3
Simulium	35	1	
Stempellinella		2	
Sublettea	1		

Aquid Invertebrate Database Bench Sheet Report
Courtois Cr [0804112], Station #1b, Sample Date: 9/30/2008 11:30:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Tabanus	1	1	
Tanytarsus	1	1	2
Thienemanniella	2		1
Thienemannimyia grp.		3	5
Tipula	1		
Tribelos			1
Tvetenia bavarica grp	6		
Tvetenia discoloripes grp	1		
EPHEMEROPTERA			
Acentrella	17		
Baetis	22		
Caenis anceps	3	4	
Caenis latipennis		11	27
Ephemerella	2		
Eurylophella	84	130	53
Heptageniidae	10	2	
Isonychia bicolor	19		
Leptophlebiidae	1	4	6
Maccaffertium pulchellum	5	1	-99
Stenacron	4	25	1
Stenonema femoratum		1	
Tricorythodes		1	
LIMNOPHILA			
Ancylidae		2	1
Menetus		1	2
Physella			1
LUMBRICINA			
Lumbricina	2	1	
MEGALOPTERA			
Nigronia serricornis	4	1	-99
MESOGASTROPODA			
Elimia	12	-99	107
ODONATA			
Argia	1		
Calopteryx			2
Gomphidae		2	
Hetaerina	1		4
Stylogomphus albistylus	9		4
PLECOPTERA			
Chloroperlidae	2	1	

Aquid Invertebrate Database Bench Sheet Report
Courtois Cr [0804112], Station #1b, Sample Date: 9/30/2008 11:30:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Zealeuctra	2		
TRICHOPTERA			
Ceratopsyche morosa grp	3		
Cheumatopsyche	58	1	1
Chimarra	5		
Helicopsyche	3	3	9
Mystacides		1	1
Polycentropus	7	6	
Triaenodes			1

Aquid Invertebrate Database Bench Sheet Report
East Fk Huzzah Cr [0804113], Station #1, Sample Date: 9/30/2008 2:25:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
"HYDRACARINA"			
Acarina	8	17	
AMPHIPODA			
Hyalella azteca			94
Stygobromus	3	7	
BRANCHIOBDELLIDA			
Branchiobdellida	14		
COLEOPTERA			
Dubiraphia		1	17
Ectopria nervosa	2	4	
Hydraena			1
Macronychus glabratus			2
Optioservus sandersoni	91	19	1
Psephenus herricki	44	44	2
Stenelmis	4	4	1
Tropisternus			1
DECAPODA			
Orconectes luteus			-99
Orconectes medius	4	-99	
Orconectes punctimanus			-99
DIPTERA			
Ablabesmyia		1	
Brillia	1		
Cardiocladius	1		
Chironomidae		3	4
Corynoneura			1
Cricotopus bicinctus	1		4
Cricotopus/Orthocladius	76	5	24
Eukiefferiella	5		
Hemerodromia	1		2
Hexatoma	15	8	
Labrundinia		2	3
Micropsectra			1
Microtendipes		3	
Nilotanypus	1	1	9
Parachaetocladius	1		
Parametriocnemus	3	2	
Paratanytarsus			2
Polypedilum convictum	3		
Potthastia	14	1	

Aquid Invertebrate Database Bench Sheet Report
East Fk Huzzah Cr [0804113], Station #1, Sample Date: 9/30/2008 2:25:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Rheocricotopus	2		1
Rheotanytarsus	15		6
Simulium	8		2
Stempellinella	5	5	
Tabanus	6	1	
Tanytarsus	1	1	1
Thienemanniella	2	1	
Thienemannimyia grp.	2	1	
Tipula			1
EPHEMEROPTERA			
Acentrella	18		
Baetis	32		
Caenis anceps	13	17	4
Caenis latipennis	3	26	60
Choroterpes		2	
Ephemerella			2
Eurylophella	30	60	49
Isonychia bicolor	61		2
Leptophlebiidae	1	53	24
Maccaffertium bednariki	7		
Maccaffertium mediopunctatum	3		
Maccaffertium pulchellum	37		
Stenacron	5	40	
Stenonema femoratum	1	29	
Tricorythodes		2	
HEMIPTERA			
Microvelia			1
Ranatra kirkaldyi			-99
LIMNOPHILA			
Ancylidae		1	7
Physella	2	2	10
LUMBRICINA			
Lumbricina	1	1	
MEGALOPTERA			
Corydalus	-99		
Nigronia serricornis	1	-99	1
Sialis		-99	
MESOGASTROPODA			
Elimia	9	1	2
ODONATA			
Argia		9	2

Aquid Invertebrate Database Bench Sheet Report
East Fk Huzzah Cr [0804113], Station #1, Sample Date: 9/30/2008 2:25:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Boyeria			1
Calopteryx		1	5
Enallagma			3
Gomphidae	5		1
Gomphus		-99	
PLECOPTERA			
Leuctridae		1	
TRICHOPTERA			
Agapetus	2		
Ceratopsyche morosa grp	4		
Cheumatopsyche	46		2
Chimarra	2		
Helicopsyche	7		
Oecetis			2
Phryganeidae			1
Polycentropus	1	10	
Triaenodes			10
TRICLADIDA			
Planariidae	2	1	

Aquid Invertebrate Database Bench Sheet Report
West Fk Huzzah Cr [0804116], Station #1, Sample Date: 10/1/2008 2:10:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
"HYDRACARINA"			
Acarina	13	16	2
AMPHIPODA			
Gammarus		3	20
Hyalella azteca		4	7
Stygobromus		1	
BRANCHIOBDELLIDA			
Branchiobdellida		8	
COLEOPTERA			
Dubiraphia		1	4
Ectopria nervosa	4		
Hydraena	1		
Optioservus sandersoni	49	16	7
Peltodytes			2
Psephenus herricki	13	8	1
Stenelmis	3	3	
DECAPODA			
Orconectes luteus	-99		
Orconectes medius		-99	-99
Orconectes punctimanus		-99	1
DIPTERA			
Ablabesmyia		20	4
Atherix	2		
Cardiocladius	1		
Ceratopogoninae		1	
Chironomidae	1	1	1
Cladotanytarsus		2	
Corynoneura		1	1
Cricotopus bicinctus			1
Cricotopus/Orthocladius	43	7	14
Dicrotendipes		3	4
Eukiefferiella	2		2
Hemerodromia	3	1	2
Labrundinia		1	5
Microtendipes	1	13	3
Parakiefferiella		5	2
Paramerina			1
Parametriocnemus	2		
Paratanytarsus		2	27
Phaenopsectra		9	

Aquid Invertebrate Database Bench Sheet Report
West Fk Huzzah Cr [0804116], Station #1, Sample Date: 10/1/2008 2:10:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Polypedilum convictum	18		1
Polypedilum fallax grp		1	
Rheocricotopus	5	4	3
Rheotanytarsus	32		10
Simulium	125	1	13
Stempellina		1	
Stempellinella	5	7	
Stictochironomus		1	1
Tabanus	1		
Tanytarsus	8	34	19
Thienemanniella	2	2	
Thienemannimyia grp.	1		7
EPHEMEROPTERA			
Acentrella	28		2
Baetis	35		
Caenis anceps	3		
Caenis latipennis	2	41	13
Callibaetis			2
Centroptilum			1
Eurylophella	3	23	12
Isonychia bicolor	41		
Leptophlebiidae	4	18	80
Maccaffertium pulchellum	56		
Stenacron	14	20	2
Stenonema femoratum		15	1
ISOPODA			
Caecidotea		1	
LIMNOPHILA			
Menetus			1
Physella		3	18
Planorbella			1
MEGALOPTERA			
Corydalus	1		
MESOGASTROPODA			
Elimia	1		2
ODONATA			
Argia	3	2	
Basiaeschna janata			-99
Calopteryx			6
Enallagma			2

Aquid Invertebrate Database Bench Sheet Report
West Fk Huzzah Cr [0804116], Station #1, Sample Date: 10/1/2008 2:10:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Gomphidae	1	1	
PLECOPTERA			
Leuctridae	2	1	
TRICHOPTERA			
Ceratopsyche morosa grp	1		
Cheumatopsyche	61		1
Chimarra	41		1
Helicopsyche	5	2	2
Hydroptila			1
Limnephilidae	1	2	4
Nectopsyche	1		
Oecetis			1
Oxyethira			1
Polycentropus	2	1	
Triaenodes		1	6
TRICLADIDA			
Planariidae	9	2	3

Aquid Invertebrate Database Bench Sheet Report
Shoal Cr [0804110], Station #1, Sample Date: 9/25/2008 2:35:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
"HYDRACARINA"			
Acarina	11	12	3
AMPHIPODA			
Hyalella azteca		3	22
COLEOPTERA			
Dubiraphia		25	25
Ectopria nervosa	9	11	1
Microcylloepus pusillus			24
Optioservus sandersoni	17	1	1
Psephenus herricki	13		
Stenelmis	86	4	5
DECAPODA			
Orconectes luteus	2	-99	
Orconectes medius	-99		
Orconectes punctimanus			1
DIPTERA			
Ablabesmyia		8	
Atherix	2		
Caloparyphus	1		
Cardiocladius	1		
Ceratopogoninae	1		
Chironomidae	1		1
Chrysops		2	
Cricotopus/Orthocladius	2		
Cryptochironomus		1	
Hemerodromia			1
Labrundinia			4
Microtendipes		1	1
Nemotelus		1	
Nilothauma		1	
Parametriocnemus	1		
Paratanytarsus		1	3
Polypedilum convictum	1		
Polypedilum scalaenum grp	1		
Rheotanytarsus	2		1
Simulium	31		
Stempellinella	2	2	
Tabanus	-99		
Tanytarsus	1		
Thienemanniella	2		1

Aquid Invertebrate Database Bench Sheet Report
Shoal Cr [0804110], Station #1, Sample Date: 9/25/2008 2:35:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Thienemannimyia grp.	8	4	8
Zavrelimyia		14	1
EPHEMEROPTERA			
Acentrella	6		
Baetis	15		
Caenis anceps	124	131	11
Caenis latipennis	50	71	76
Centroptilum			3
Eurylophella	25	3	10
Isonychia bicolor	18		
Leptophlebiidae	4	4	30
Maccaffertium pulchellum	57		
Stenacron	22	1	
Stenonema femoratum	5	5	2
Tricorythodes	5		
HEMIPTERA			
Belostoma			1
Microvelia			3
Rhagovelia	1		
ISOPODA			
Caecidotea	2		2
LEPIDOPTERA			
Crambidae	1		
Petrophila	1		
LIMNOPHILA			
Menetus			2
Physella		-99	6
LUMBRICINA			
Lumbricina	2		
MEGALOPTERA			
Corydalus	1	-99	
Nigronia serricornis	2		
Sialis	1	-99	
MESOGASTROPODA			
Elimia		-99	1
ODONATA			
Argia	7		11
Boyeria			-99
Enallagma			6
Gomphidae	7		

Aquid Invertebrate Database Bench Sheet Report
Shoal Cr [0804110], Station #1, Sample Date: 9/25/2008 2:35:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Hagenius brevistylus		-99	
Stylogomphus albistylus		2	
PLECOPTERA			
Leuctridae	2		
Neoperla	1		
TRICHOPTERA			
Ceratopsyche morosa grp	2		
Cheumatopsyche	12		
Chimarra	5		
Helicopsyche	28	2	1
Nectopsyche		1	
Oecetis	5	2	1
Polycentropus	4		
Triaenodes			5
TRICLADIDA			
Planariidae	7		
TUBIFICIDA			
Enchytraeidae		1	
Tubificidae		4	
VENEROIDA			
Pisidiidae		2	

Aquid Invertebrate Database Bench Sheet Report
Pond Cr [0930003], Station #2, Sample Date: 3/23/2009 1:35:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
"HYDRACARINA"			
Acarina	13	16	1
AMPHIPODA			
Gammarus	8	6	29
BRANCHIOBDELLIDA			
Branchiobdellida	2		
COLEOPTERA			
Dubiraphia		4	22
Dytiscidae		1	1
Ectopria nervosa			1
Macronychus glabratus			1
Microcylloepus pusillus		2	7
Optioservus sandersoni	4	2	1
Stenelmis	2		1
DECAPODA			
Orconectes medius	1	-99	
DIPTERA			
Ablabesmyia	2		
Antocha	4		
Ceratopogoninae	6	7	13
Chironomidae	1	1	4
Chrysops		1	
Cladotanytarsus	2		
Clinocera		2	
Corynoneura			1
Cricotopus bicinctus	2	1	4
Cricotopus/Orthocladius	119	26	26
Cryptochironomus	2	1	1
Dixa			1
Dixella			1
Epoicocladius	1		
Eukiefferiella	20	1	1
Hemerodromia	47	7	16
Micropsectra	1	1	5
Natarsia		1	1
Neozavrelia	1		
Parakiefferiella	17	36	2
Parametriocnemus	3		2
Paratanytarsus			5
Phaenopsectra		2	
Polypedilum aviceps	7		1

Aquid Invertebrate Database Bench Sheet Report
Pond Cr [0930003], Station #2, Sample Date: 3/23/2009 1:35:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Polypedilum convictum	3		
Polypedilum halterale grp		1	
Polypedilum illinoense grp			3
Prosimulium	5		
Psectrocladius			1
Rheocricotopus	8		4
Rheotanytarsus	20	1	3
Simulium	39		1
Stempellinella	13	9	8
Stenochironomus	1		
Tabanus			-99
Tanytarsus	12	28	11
Thienemanniella	3	3	1
Thienemannimyia grp.	8		5
Tipula	-99		-99
Tvetenia	4		2
undescribed Empididae			1
EPHEMEROPTERA			
Acentrella	6		1
Caenis latipennis	96	164	65
Diphetor	1	1	
Eurylophella bicolor		2	
Eurylophella enoensis	1		1
Heptageniidae	1		
Isonychia bicolor	9		
Maccaffertium pulchellum	18	1	
Stenacron	49	13	-99
Stenonema femoratum	1	1	
ISOPODA			
Caecidotea	4		4
LEPIDOPTERA			
Petrophila		-99	
MEGALOPTERA			
Corydalus	1		
Nigronia serricornis	1	-99	1
Sialis		-99	
ODONATA			
Argia		1	1
Basiaeschna janata	1		
Calopteryx	1		
Gomphus	1	1	

Aquid Invertebrate Database Bench Sheet Report
Pond Cr [0930003], Station #2, Sample Date: 3/23/2009 1:35:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Hagenius brevistylus			2
PLECOPTERA			
Amphinemura	11		1
Leuctridae	25		2
Perlesta	17	2	3
TRICHOPTERA			
Cheumatopsyche	8	2	5
Chimarra	1		
Hydropsyche	2		1
Hydroptila		2	1
Ironoquia			1
Mystacides		2	
Oecetis			2
Polycentropodidae	1		
Polycentropus			4
Pycnopsyche			2
Triaenodes			4
TRICLADIDA			
Planariidae	1		3
TUBIFICIDA			
Enchytraeidae			1
Tubificidae	3	9	1
VENEROIDA			
Pisidiidae		1	1

Aquid Invertebrate Database Bench Sheet Report
Pond Cr [0930002], Station #1, Sample Date: 3/23/2009 12:00:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
"HYDRACARINA"			
Acarina	1	18	
AMPHIPODA			
Hyalella azteca			17
BRANCHIOBDELLIDA			
Branchiobdellida	1		
COLEOPTERA			
Dubiraphia		19	15
Microcylloepus pusillus			3
Optioservus sandersoni	12	1	
Paracymus			1
Psephenus herricki		1	
Stenelmis		1	8
DECAPODA			
Orconectes luteus	-99	-99	
Orconectes medius	2		
Orconectes punctimanus			-99
DIPTERA			
Ablabesmyia		3	
Antocha	1	1	
Ceratopogoninae		26	
Chironomidae	2	5	5
Cladotanytarsus		8	
Clinocera	10	11	1
Corynoneura	5	3	1
Cricotopus bicinctus	2		4
Cricotopus/Orthocladius	37	14	59
Cryptochironomus		3	
Dicrotendipes		1	
Eukiefferiella	46	2	3
Hemerodromia	6	6	1
Labrundinia			12
Micropsectra		2	1
Microtendipes		1	
Natarsia		5	
Orthocladius (Euorthocladius)	3		
Parakiefferiella	2	23	9
Parametriocnemus	7		
Paratanytarsus	1		55
Phaenopsectra		1	1

Aquid Invertebrate Database Bench Sheet Report
Pond Cr [0930002], Station #1, Sample Date: 3/23/2009 12:00:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Polypedilum aviceps	8		1
Polypedilum halterale grp		1	
Polypedilum illinoense grp			1
Prosimulium	18		
Rheocricotopus	22		
Rheotanytarsus	8		6
Simulium	102		
Stempellina		3	
Stempellinella	4	21	2
Tabanus	1		
Tanytarsus	4	34	8
Thienemanniella	19	4	4
Thienemannimyia grp.	3	2	8
Tipula	1		
Tvetenia	14		
EPHEMEROPTERA			
Acentrella	15		
Baetisca lacustris		2	
Caenis latipennis	5	26	31
Diphetor	2		
Ephemera simulans		-99	
Eurylophella bicolor		35	20
Eurylophella enoensis			21
Isonychia bicolor	15		
Leptophlebia		1	
Maccaffertium mediopunctatum	1		
Maccaffertium pulchellum	20		3
Paraleptophlebia			1
Stenacron	3	5	
Stenonema femoratum	-99	6	1
GORDIOIDEA			
Gordiidae	-99		
LEPIDOPTERA			
Petrophila	2		
LUMBRICINA			
Lumbricina	2	-99	
MEGALOPTERA			
Corydalus	1		
Nigronia serricornis	4		
MESOGASTROPODA			

Aquid Invertebrate Database Bench Sheet Report
Pond Cr [0930002], Station #1, Sample Date: 3/23/2009 12:00:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Elimia	1		
ODONATA			
Argia			6
Calopteryx			2
Enallagma			8
Gomphidae	2	-99	1
Helocordulia		-99	
Stylogomphus albistylus		-99	1
PLECOPTERA			
Acroneuria	1		
Amphinemura	12		1
Leuctridae	31	4	2
Perlesta	1		
Strophopteryx	4		
TRICHOPTERA			
Cheumatopsyche	11		
Chimarra	3		
Helicopsyche	1		
Polycentropus			2
Pycnopsyche			-99
Rhyacophila	2	1	4
Triaenodes			1
TRICLADIDA			
Planariidae	3		3
TUBIFICIDA			
Tubificidae		5	
VENEROIDA			
Corbicula		3	

Aquid Invertebrate Database Bench Sheet Report
Shibboleth Br [0930012], Station #3, Sample Date: 4/1/2009 11:20:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
"HYDRACARINA"			
Acarina	4	20	4
COLEOPTERA			
Dubiraphia		3	19
Ectopria nervosa	1		
Hydroporus		6	
Macronychus glabratus	1		2
Microcylloepus pusillus	2		
Optioservus sandersoni	9		1
DECAPODA			
Orconectes medius	-99		
Procambarus acutus			-99
DIPTERA			
Ablabesmyia		4	2
Ceratopogoninae	1	13	5
Chironomidae	4	4	5
Clinocera	3	2	
Corynoneura			4
Cricotopus bicinctus	2		4
Cricotopus/Orthocladius	12	6	23
Cryptochironomus		1	
Diptera	2	1	
Hemerodromia	15	9	11
Labrundinia			2
Natarsia			1
Nilotanypus	6	1	1
Parakiefferiella	1	4	
Parametriocnemus	20	3	5
Paratanytarsus	1		4
Polypedilum aviceps	63	6	13
Polypedilum illinoense grp	1		5
Procladius			1
Rheocricotopus	34	13	15
Rheotanytarsus	5	2	7
Simulium	50		25
Stempellinella	6	18	5
Tabanus	-99		
Tanypus		1	
Tanytarsus	28	57	19
Thienemanniella	1	3	9

Aquid Invertebrate Database Bench Sheet Report
Shibboleth Br [0930012], Station #3, Sample Date: 4/1/2009 11:20:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Thienemannimyia grp.	10	3	5
Tipula	2		
Zavrelimyia		6	1
EPHEMEROPTERA			
Acentrella	4		
Caenis latipennis	5	11	11
Eurylophella bicolor		1	3
Isonychia bicolor	27		1
Leptophlebiidae	1		
Maccaffertium pulchellum	44	4	4
Stenacron	11	10	1
ISOPODA			
Caecidotea	7	2	9
LIMNOPHILA			
Lymnaeidae	2		
LUMBRICINA			
Lumbricina			1
MEGALOPTERA			
Nigronia serricornis	2	-99	
ODONATA			
Argia		2	
Calopteryx			6
Gomphidae	2	3	
Gomphus	1		
Stylogomphus albistylus	1	-99	
PLECOPTERA			
Amphinemura	10		3
Leuctridae	163	76	44
Perlesta	10		1
TRICHOPTERA			
Cheumatopsyche	48		
Chimarra	12		
Oecetis	1		1
Oxyethira			5
Polycentropus	3	3	6
Pycnopsyche		-99	1
Rhyacophila	8	1	1
Triaenodes		1	
TRICLADIDA			
Planariidae	5	1	2

Aquid Invertebrate Database Bench Sheet Report
Shibboleth Br [0930012], Station #3, Sample Date: 4/1/2009 11:20:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
TUBIFICIDA			
Tubificidae			1
VENEROIDA			
Pisidiidae	2	1	

Aquid Invertebrate Database Bench Sheet Report
Shibboleth Br [0930006], Station #2, Sample Date: 3/25/2009 11:50:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
"HYDRACARINA"			
Acarina	8	3	1
COLEOPTERA			
Dubiraphia		20	12
Macronychus glabratus			3
Microcylloepus pusillus	13		
Optioservus sandersoni	6		3
Psephenus herricki	1		
Stenelmis	3		3
DECAPODA			
Cambarus maculatus	-99		
Orconectes harrisonii		-99	
Orconectes punctimanus			-99
DIPTERA			
Ablabesmyia		5	5
Brillia			1
Cardiocladius	8		
Ceratopogoninae		1	1
Chironomidae	3	4	2
Clinocera	1		
Clinotanypus			2
Corynoneura			1
Cricotopus bicinctus			8
Cricotopus trifascia	2		
Cricotopus/Orthocladius	39	25	29
Dasyheleinae	1		
Dixella			6
Eukiefferiella	1		
Forcipomyiinae			1
Hemerodromia	16	5	7
Labrundinia			2
Microtendipes		1	
Nanocladius		1	
Natarsia		4	
Nilotanypus	1		
Parakiefferiella		9	4
Parametriocnemus	5	1	1
Paratanytarsus	1	1	37
Polypedilum aviceps	51	2	9
Polypedilum illinoense grp	1		23

Aquid Invertebrate Database Bench Sheet Report
Shibboleth Br [0930006], Station #2, Sample Date: 3/25/2009 11:50:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Prosimulium	1		
Rheocricotopus	21		6
Rheotanytarsus	20	2	4
Simulium	105		1
Stempellinella	4	24	10
Stenochironomus		1	
Tanytarsus	2	52	16
Thienemanniella	2	5	2
Thienemannimyia grp.	16		2
Tipula	-99		
Tribelos		4	
Tvetenia	63		2
Zavrelimyia			2
EPHEMEROPTERA			
Acentrella	5		
Caenis latipennis	6	85	45
Diphetor	1		
Ephemera simulans		2	
Eurylophella enoensis	4	3	11
Heptageniidae	6	1	
Hexagenia limbata		-99	
Isonychia bicolor	34		1
Maccaffertium mediopunctatum	3		
Maccaffertium pulchellum	23		1
Paraleptophlebia	2		
Stenacron		2	
Stenonema femoratum		2	
Tricorythodes	1		
ISOPODA			
Caecidotea	81	34	67
LIMNOPHILA			
Menetus		1	
LUMBRICINA			
Lumbricina	-99		
LUMBRICULIDA			
Lumbriculidae			1
MEGALOPTERA			
Corydalus	1		
Nigronia serricornis			2
ODONATA			
Argia	1		

Aquid Invertebrate Database Bench Sheet Report
Shibboleth Br [0930006], Station #2, Sample Date: 3/25/2009 11:50:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Calopteryx			-99
Dromogomphus			-99
Enallagma			3
Hagenius brevistylus		1	
Macromia			-99
Stylogomphus albistylus			-99
PLECOPTERA			
Acroneuria	1		
Amphinemura	27		
Clioperla clio	-99		
Isoperla	1		
Leuctridae	50	1	2
Perlesta	13		3
TRICHOPTERA			
Ceratopsyche morosa grp	2		
Cheumatopsyche	10		1
Chimarra	25		
Hydroptila	1		
Oecetis		1	6
Oxyethira		1	
Polycentropus	3		13
Pycnopsyche	-99	-99	1
Rhyacophila	5		-99
Triaenodes			3
TRICLADIDA			
Planariidae	7		1
TUBIFICIDA			
Branchiura sowerbyi		1	
Quistradrilus multisetosus			1
Tubificidae	1	4	4
VENEROIDA			
Pisidiidae		1	6

Aquid Invertebrate Database Bench Sheet Report
Shibboleth Br [0930005], Station #1, Sample Date: 3/25/2009 10:45:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
"HYDRACARINA"			
Acarina	12		7
AMPHIPODA			
Hyalella azteca			2
BRANCHIOBDELLIDA			
Branchiobdellida			1
COLEOPTERA			
Dubiraphia	4	31	24
Macronychus glabratus			2
Microcylloepus pusillus	1		
Optioservus sandersoni	3		
Stenelmis	18	1	1
DECAPODA			
Orconectes harrisonii	1		
Orconectes luteus	-99		
Orconectes medius	-99		
Orconectes punctimanus			-99
DIPTERA			
Ablabesmyia		13	13
Antocha			1
Atherix	-99		
Brillia			2
Ceratopogoninae	1		3
Chironomidae	3	5	5
Chrysops			1
Cladotanytarsus	1	15	
Cricotopus bicinctus	1		7
Cricotopus/Orthocladius	40	10	36
Cryptochironomus		2	
Cryptotendipes		2	
Diptera		5	
Dixa			4
Epoicocladius	1		
Eukiefferiella	1		
Hemerodromia	26	3	4
Labrundinia			9
Microtendipes	2	13	
Nanocladius		1	
Natarsia			4
Nilotanypus	3		

Aquid Invertebrate Database Bench Sheet Report
Shibboleth Br [0930005], Station #1, Sample Date: 3/25/2009 10:45:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Parakiefferiella		15	14
Paralauterborniella		1	
Parametriocnemus	19	1	
Paratanytarsus	3	6	21
Paratendipes		2	
Phaenopsectra		11	1
Polypedilum aviceps	22		1
Polypedilum convictum	3		
Polypedilum halterale grp		2	
Polypedilum illinoense grp	1	2	16
Procladius		1	
Rheocricotopus	45		5
Rheotanytarsus	23		9
Simulium	10		
Stempellinella	25	31	7
Stictochironomus		1	
Tanytarsus	24	48	19
Thienemanniella	7	1	1
Thienemannimyia grp.	13	1	6
Tribelos		7	
Tvetenia	32		
Zavrelimyia		1	
EPHEMEROPTERA			
Acentrella	2		
Caenis anceps	11	3	
Caenis latipennis	59	65	19
Centroptilum			3
Diphetor	3		
Ephemera	-99	-99	
Eurylophella	12		7
Eurylophella bicolor	1	3	3
Eurylophella enoensis		4	6
Heptageniidae	36		
Hexagenia			1
Isonychia bicolor	22		
Leptophlebia		1	
Maccaffertium mediopunctatum	10		
Maccaffertium pulchellum	21		
Paraleptophlebia	3		
Stenacron	4	1	3
Stenonema femoratum		5	1

Aquid Invertebrate Database Bench Sheet Report
Shibboleth Br [0930005], Station #1, Sample Date: 3/25/2009 10:45:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Tricorythodes	10		
ISOPODA			
Caecidotea	72	5	12
LIMNOPHILA			
Ferrissia			1
Helisoma			1
LUMBRICINA			
Lumbricina	1		-99
MEGALOPTERA			
Corydalus	-99		
Nigronia serricornis	-99		-99
Sialis		-99	
MESOGASTROPODA			
Elimia			-99
ODONATA			
Argia		1	2
Calopteryx			1
Enallagma			1
Hetaerina			1
Macromia			1
PLECOPTERA			
Acroneuria	-99		
Amphinemura	15		1
Leuctridae	39		1
Perlesta	16		2
RHYNCHOBDELLIDA			
Glossiphoniidae		1	
TRICHOPTERA			
Cheumatopsyche	14		1
Chimarra	4		
Helicopsyche	4		
Mystacides		1	
Oecetis		1	3
Oxyethira			2
Polycentropus	1		1
Pycnopsyche	-99		5
Rhyacophila	6		
Triaenodes			6
TRICLADIDA			
Planariidae	3		2

Aquid Invertebrate Database Bench Sheet Report
Shibboleth Br [0930005], Station #1, Sample Date: 3/25/2009 10:45:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
TUBIFICIDA			
Branchiura sowerbyi		2	3
Enchytraeidae		1	
Limnodrilus claparedianus		1	
Limnodrilus hoffmeisteri			1
Quistradrilus multisetosus			2
Tubificidae	1	3	1
VENEROIDA			
Corbicula	1		
Pisidiidae		1	1

Appendix C

Fine Sediment Percentage Statistical Analysis:
Kruskal-Wallis One Way Analysis of Variance on Ranks
Test Stations vs Controls Mean
(Pond Creek=Pond C; SB=Shibboleth Branch)

One Way Analysis of Variance Thursday, April 02, 2009, 12:52:42 PM

Data source: Data 1 in Tribs 2008 Stats

Dependent Variable: percent

Normality Test: Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

Kruskal-Wallis One Way Analysis of Variance on Ranks Thursday, April 02, 2009, 12:52:42 PM

Data source: Data 1 in Tribs 2008 Stats

Group	N	Missing	Median	25%	75%
Pond Cr #2	18	0	95.000	90.000	95.000
Pond Cr #1	18	0	27.000	23.000	55.000
SB #3	18	0	15.000	5.000	87.000
SB #2	18	0	35.000	13.000	80.000
SB #1	18	0	36.500	15.000	77.000
TOM	18	0	62.500	20.000	83.000
SPC	18	0	11.000	5.000	33.000
FFB	18	0	45.000	13.000	91.000
Controls	90	0	7.000	3.000	20.000

H = 94.461 with 8 degrees of freedom. (P = <0.001)

The differences in the median values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = <0.001)

To isolate the group or groups that differ from the others use a multiple comparison procedure.

Multiple Comparisons versus Control Group (Dunn's Method) :

Comparison	Diff of Ranks	Q	P<0.05
PC 2 vs Control	142.806	8.170	Yes
TOM vs Control	81.083	4.639	Yes
FFB vs Control	75.472	4.318	Yes
SB2 vs Control	67.389	3.856	Yes
SB1 vs Control	64.694	3.701	Yes
PC 1 vs Control	62.722	3.589	Yes
SB3 vs Control	44.806	2.563	No
SPC vs Control	13.889	0.795	Do Not Test

Note: The multiple comparisons on ranks do not include an adjustment for ties.